

# NUCLEAR SCIENCE ABSTRACTS

Vol. 8, No. 2, January 31, 1954

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## CALENDAR OF MEETINGS

Suggestions for additions to this list will be welcomed and should be sent with all pertinent information to the Cataloging Branch, Technical Information Service, U. S. Atomic Energy Commission, P. O. Box 62, Oak Ridge, Tennessee.

March 15-19, 1954

ELEVATED TEMPERATURE CORROSION SYMPOSIUM, Municipal Auditorium, Kansas City, Mo. Sponsored by: National Association of Corrosion Engineers—10th Annual Conference

Inquiries should be addressed to: Glenn A. Fitzlen, Ass't. Technical Director, Haynes Stellite Co., Kokomo, Indiana.

June 20-25, 1954

NUCLEAR ENGINEERING CONFERENCE, University of Michigan, Ann Arbor, Michigan, Sponsored by: American Institute of Chemical Engineers.

Inquiries should be addressed to: Professor Donald Katz, University of Michigan, Department of Engineering, Ann Arbor, Michigan.

July 19-24, 1954

SECOND RADIOISOTOPE CONFERENCE (a conference on the peaceful uses of atomic energy), Oxford, England,

Arranged by: The Atomic Energy Research Establishment, Harwell.

Inquiries should be addressed to: The Conference Secretary, Atomic Energy Research Establishment, Harwell, Didcot, Berks, England.



## BIOLOGY AND MEDICINE

426

Rochester Univ. School of Medicine and Dentistry  
STUDIES IN RESPIRATORY PHYSIOLOGY. CHEMISTRY  
AND MECHANICS OF PULMONARY VENTILATION. W. O.  
Fenn, A. B. Otis, and H. Rahn. Aug. 1951. 560p. Contract  
W-33-038-ac-14716. (AF-TR-6528; ATI-125852)

427

Brookhaven National Lab.  
EFFECTS OF TRIIODOTHYRONINE ON TADPOLES.  
C. J. Shellabarger and John T. Godwin. [1953] 8p.  
(BNL-1587)

D-L-Triiodothyronine and D-L-thyroxine were effective  
in shortening the body length of tadpoles immersed in  
these compounds for 10 days. An estimation of relative  
potency indicated that triiodothyronine was approximately  
3.5 times as effective as thyroxine. (auth)

428

Brookhaven National Lab.  
THE MECHANISM OF PENTOSE PHOSPHATE CONVER-  
SION TO HEXOSE MONOPHOSPHATE. 1. WITH A LIVER  
ENZYME PREPARATION. B. L. Horecker, M. Gibbs,  
H. Klenow, and P. Z. Smyrniotis, National Inst. of  
Arthritis and Metabolic Diseases, National Institutes of  
Health and Brookhaven National Lab. [1953] 25p. (BNL-  
1609)

The formation of hexose monophosphate from pentose  
phosphate by rat liver preparations has been studied with  
 $C^{14}$ -labeled substrates. Pentose phosphate-1- $C^{14}$  gave rise  
to 1,3-labeled hexose monophosphate, with most of the  
isotope in the 1-position. Pentose phosphate-2,3- $C^{14}$  yielded  
hexose monophosphate with radioactivity in four of the six  
C atoms. Nearly  $\frac{1}{2}$  of the total activity appeared in position  
4. C atoms 2 and 3 were approximately equally labeled,  
and a small but significant amount of activity was found in  
carbon 1. The liver enzyme preparation was able to  
hydrolyze fructose diphosphate to fructose-6-phosphate,  
but only in the presence of added  $Mg^{++}$ . From the isotope  
data it is concluded that, in addition to the transaldolase  
and transketolase reactions, the liver preparation catalyzes  
one or more additional reactions leading to the formation of  
hexose monophosphate from pentose phosphate. (auth)

429

Naval Research Lab.  
FUNGICIDE ATTENUATION BY OILS. [INTERIM REPORT].  
John M. Leonard and Helen Louise Larson. Oct. 20, 1953.  
10p. (NRL-4228)

430

Radiation Lab., Univ. of Calif., Berkeley  
MEDICAL AND HEALTH PHYSICS QUARTERLY REPORT,  
APRIL, MAY, AND JUNE 1953. Sept. 21, 1953. 61p.  
Contract W-7405-eng-48. (UCRL-2345)

Separate abstracts have been prepared on two sections of  
this report. (For preceding period see UCRL-2343.) (C.H.)

431

Radiation Lab., Univ. of Calif., Berkeley  
BIOLOGICAL STUDIES OF RADIATION EFFECTS AND

METABOLIC PROPERTIES OF VARIOUS MATERIALS.  
p.3-47 of MEDICAL AND HEALTH PHYSICS QUARTERLY  
REPORT, APRIL, MAY, AND JUNE 1953. Sept. 21, 1953.  
45p. Contract W-7405-eng-48. (UCRL-2345(p.3-47))

Data on the survival of haploid yeast following exposure  
to x radiation were re-examined, and evidence is presented  
which confirms the high radioresistance of budding yeast  
cells and establishes these cells as the radioresistant  
component of the populations studied. A relatively simple  
counter for very weak  $\beta$  particles is described. The main  
features of the instrument are an efficient liquid-scintillator  
solution and a photomultiplier tube that has a very high  
signal-to-noise ratio and is cooled to further reduce the  
noise background. The method is suitable for counting  $H^3$ -  
or  $C^{14}$ -labeled compounds that are soluble in ordinary fat  
solvents. Data are tabulated on the hematological effects  
of  $\alpha$  particles from injected  $At^{211}$  in rats and monkeys.  
Photographs are included of radiographs of representative  
regions of the skeleton of a normal monkey approximately  
3 yr old. (C.H.)

432

Radiation Lab., Univ. of Calif., Berkeley  
RADIATION CHEMISTRY AND HEALTH CHEMISTRY.  
p.48-61 of MEDICAL AND HEALTH PHYSICS QUARTERLY  
REPORT, APRIL, MAY, AND JUNE 1953. Sept. 21, 1953.  
14p. Contract W-7405-eng-48. (UCRL-2345(p.48-61))

Data are presented from studies of products formed in  
solutions of acetic acid by reactions resulting from irradiation  
with 35-Mev He ions and 18-Mev deuterons. Methods  
for the determination of aldehydes and ketones in irradiated  
solutions of organic acids are discussed. Progress is  
reported on the problem of target preparation and volatile-  
product analysis in studies of the radiation chemistry of  
aqueous glycine solutions. Paraffin dissolved in  $CCl_4$  was  
found to be the most satisfactory of several coatings tested  
for preventing radioactive materials from becoming im-  
bedded in the pores of concrete surfaces. Sno-Gel proved  
useful for solidifying active liquid wastes before incorpora-  
tion in cement drums for disposal at sea. Routine health  
physics monitoring activities for the period are summarized.  
(C.H.)

## AEROSOLS

433

Air Cleaning Lab., Harvard School of Public Health  
PERFORMANCE OF COMMERCIAL DUST COLLECTORS.  
(REPORT OF FIELD TESTS). Richard Dennis, Glenn A.  
Johnson, Melvin W. First, and Leslie Silverman. Issued  
Nov. 2, 1953. 45p. Contract AT(30-1)-841. (NYO-1588)

An investigation was made of the performance of common  
types of commercial aircleaning equipment for the collection  
of a variety of industrial aerosols. Test results are reported  
for dry inertial type collectors, cloth screen and tube filters,  
reverse jet filters, wet scrubbers, and low-voltage  
electrostatic precipitators. (C.H.)

## RADIATION EFFECTS

434

Brookhaven National Lab.  
TOLERANCE OF CERTAIN HIGHER PLANTS TO CHRONIC



EXPOSURE TO GAMMA RADIATION FROM COBALT<sup>60</sup>.

Arnold H. Sparrow and Eric Christensen. [1953] 8p. (BNL-1588)

The radiation tolerance of 31 species of higher plants to chronic  $\gamma$  irradiation from Co<sup>60</sup> was determined. The most sensitive plants studied were Lilium longiflorum and Tradescantia paludosa which showed a severe effect on growth with chronic exposures of 30 to 40 r per day. The two most resistant plants were broccoli and Gladiolus which showed severe effects at about 2500 and 6000 r per day, respectively. The range of tolerance in the 31 species examined is thus about 200 fold. The reasons for the different tolerances were not investigated, but it is suggested that plants with large chromosomes tend to be more sensitive than most plants with small chromosomes. (auth)

435

Brookhaven National Lab.

## ROOT PRODUCTION IN PLANTS FOLLOWING LOCALIZED STEM IRRADIATION. Eric Christensen. [nd] 7p. (BNL-1596)

Acute x irradiation applied to short regions of the stems of certain intact seedlings caused development of adventitious roots immediately above the irradiated site. Effective dosages varied with the species and showed a wide range in any one species. Roots were produced in Xanthium with from 1500 to 12000 r; in Nicotiana glauca with 6000 r; in Lycopersicum esculentum with 24000 r; and in Phaseolus with 16000 r. It is suggested that a phloem block occurs in the irradiated region, causing downward-moving organic materials to accumulate in the untreated portion of the stem immediately above the treated site. This could explain the swelling and the subsequent production of roots at this place. Upward transport of water from the roots seems unaffected. (auth)

436

Brookhaven National Lab.

## GROWTH AND MUTATION OF BACTERIA DURING CONTINUOUS IRRADIATION. B. A. Rubin. [1953] 35p. (BNL-1617)

Bacteria were grown during continuous irradiation of up to 10,000 r/hr. Growth was observed to occur at a rate equal to nonirradiated controls, and the maximum crop of cellular material was also equal. Only the period before the inception of growth increased as a function of a dose. Under these conditions the mutation frequency increased as a function of total radiation dose, regardless of how much growth had occurred during irradiation. The nucleic acid content of cultures grown during continuous radiation was indistinguishable from controls. (auth)

437

Massachusetts Inst. of Tech.

## QUARTERLY PROGRESS REPORT FOR THE PERIOD JULY 1, 1953 TO SEPTEMBER 30, 1953. Bernard E. Proctor and Samuel A. Goldblith. Oct. 1, 1953. 11p. Contract AT(30-1)-1164. (NYO-3341)

Developments are reported in the theoretical derivation of the effect of non-uniform distribution of ionization density within an absorber and its significance in relation to the mean lethal dose of microorganisms exposed to such radiations. Data are presented on the relative bactericidal effects of high energy  $\gamma$ , x, and cathode rays on the spores of B. thermoacidurans in saline. Modifications in bacterial radiosensitivity produced by varying the thickness, volume, atmosphere, and medium are discussed. (For preceding period see NYO-3340.) (C.H.)

438

Atomic Bomb Casualty Commission

## INTERIM REPORT [FOR] JANUARY 1 THROUGH JUNE 30, 1951. PART 1. RESEARCH. 115p. (NYO-4432)

The research program of the Atomic Bomb Casualty Commission aimed at the evaluation of biological effects of radiation from atomic bombs on citizens of Hiroshima and Nagasaki is summarized. Data are presented from genetic studies, pediatric and adult medical studies, radiographic and diagnostic radiology studies, activities of the nursing service, and autopsy studies on both exposed and control groups. (C.H.)

439

TERMINAL PHENOMENA ASSOCIATED WITH MASSIVE DOSES OF X-RAYS. Howard L. Andrews and Kirkland C. Brace. Am. J. Physiol. 175, 138-40(1953) Oct.

A series of 22 guinea pigs were exposed to 25,000 r of x rays over the whole body or with various areas shielded. Measurements of rectal temperature, electrocardiograms, and single-lead electroencephalograms were taken at intervals until death or sacrifice for blood studies. All animals showed a striking drop in the heart rate and body temperature, and slow waves appeared in the electroencephalogram. Clinical signs of central nervous system dysfunction appeared after a few thousand r had been delivered, and these persisted until death. The dysfunction appears to be subcortical and is not the direct result of ionization in the brain tissue. (auth)

440

EFFECT OF WHOLE BODY X-IRRADIATION ON BLOOD CONSTITUENTS. W. E. Cornatzer, O. Engelstad, and John P. Davison. Am. J. Physiol. 175, 153-5(1953) Oct.

Various constituents in the plasma have been determined in the dog before and after 500-r whole-body x irradiation. A statistically significant rise in plasma cholesterol, uric acid, and a decrease in albumin-globulin ratio and percentage of cholesterol ester occur. (auth)

441

OSSEOUS DAMAGE IN IRRADIATION OF RENAL TUMORS IN INFANCY AND CHILDHOOD. Walter M. Whitehouse and Isadore Lampe. Am. J. Roentgenol. Radium Therapy Nuclear Med. 70, 721-9(1953) Nov.

Four patients surviving ten years or more following irradiation for renal tumors in infancy or childhood demonstrated vertebral damage and unilateral underdevelopment of the ilium of varying degree. The degree of bone damage appears to be related to factors in dosage; adequate protraction with small daily doses, smaller field size, and lower total dosage lead to diminution of eventual bone damage. The problem of avoiding excessive damage becomes one of determining the level to which the radiation intensity can be reduced within the limits of effective tumor treatment. An inoperable proved case of Wilms' tumor survived following an intensive course of irradiation with resultant severe vertebral damage and scoliosis. A postoperative case of Wilms' tumor with apparent residual neoplasm survived following protracted irradiation with resultant minimal vertebral damage and no scoliosis; the change in dosage factors was apparently still within the limits of effective tumor treatment in this case. Further evaluation of this problem is suggested by correlating data on bone damage in the increasing number of long term survivals following irradiation for renal tumors in infancy and childhood. (auth)

442

EFFECTS OF IRRADIATION ON ANABOLISM OF ANTIBODY AND OF SERUM ALBUMIN AND GLOBULIN. Kingsley M. Stevens, Irving Gray, and Melvin S. Schwartz. Am. J. Physiol. 175, 141-6(1953) Oct.

The effect of 500 r of whole-body x irradiation upon the uptake of S<sup>35</sup>-methionine into antibody, serum globulin, serum albumin, and total protein in normal and immunized rabbits was studied. Incorporation into antibody was depressed 30 to 50% by x rays. Incorporation into serum



globulin or serum albumin was greatly stimulated by x rays. It is felt that these effects of x rays are best explained by a primary effect upon desoxyribonucleic acid metabolism. (auth)

443

**SYNERGISTIC EFFECT OF INTERNAL IRRADIATION AND PHLEBOTOMY ON PRODUCTION OF CIRRHOSIS AND ASCITES IN DOGS.** P. F. Hahn, Ella Lea Carothers, and Houston Brummit. *Am. J. Physiol.* **175**, 162-6(1953) Oct.

The intravenous administration of large amounts of radioactive Au colloid results in the massive irradiation of the liver and spleen. In young dogs this may result in ascites and hepatic cirrhosis, but in a large series of adult dogs under similar conditions ascites did not develop. When phlebotomy was superimposed upon such irradiation procedures, it was found possible to produce ascites in adult dogs even when the total irradiation of the liver and spleen was several times smaller than that used with intravenous injections of Au alone. (auth)

444

**INDUCTION OF PITUITARY TUMORS BY MEANS OF IONIZING IRRADIATION.** A. C. Upton and J. Furth. *Proc. Soc. Exptl. Biol. Med.* **84**, 255-7(1953) Oct.

Pituitary tumors were induced in mice by a single exposure to ionizing irradiation. The greatest incidence occurred among mice exposed to doses of  $\gamma$  radiation somewhat below the LD<sub>50</sub>. These tumors were about four times more frequent among females than among males. Neutrons appear more efficient in inducing these neoplasms than  $\gamma$  rays, and the data suggest that doses as low as 40 to 70 rem may induce such tumors. The period of latency of these neoplasms is very long, the maximum incidence being at 17 to 25 months postirradiation. (auth)

445

**EVIDENCE FOR X-RAY INDUCED RECESSIVE LETHAL MUTATIONS IN YEAST.** Robert K. Mortimer and Cornelius A. Tobias. *Science* **118**, 517-8(1953) Oct. 30.

Evidence is presented which demonstrates the presence of x-ray-induced recessive lethal mutations following exposure of cultures of diploid yeast to doses of 2500 r and 7500 r x radiation. Extension of the radiobiological data on haploid and diploid yeast to triploid and tetraploid yeast cells indicates that some other form of lethal damage is also induced by x rays. (C.H.)

#### RADIATION HAZARDS AND PROTECTION

446

Oak Ridge National Lab.

**HEALTH PHYSICS DIVISION SEMI-ANNUAL PROGRESS REPORT FOR PERIOD ENDING JULY 31, 1953.** K. Z. Morgan. Issued Oct. 20, 1953. 39p. Contract W-7405-eng-26. (ORNL-1596)

Progress is reported on studies of the disordering of solids by heavy corpuscular radiation; the energy losses of moving charged particles; neutron dosimetry; ionization by  $\alpha$  particles; development of equipment for airborne U prospecting; maximum permissible Co<sup>60</sup>-concentration experiments in mice; the spectrographic analysis of human tissue; the determination of radioactive Sr in urine; the measurement of ionizing radiation by high-frequency variation; backscattering of  $\beta$  particles; development of a film badge for fast-neutron monitoring; the attenuation of x radiation in ordinary concrete block and in barytes-loaded concrete block; response of film used in dosimetry badges; determinations of airborne radioparticulate contamination; determination of activity escaping from the graphite reactor filter house; construction of a cloud chamber for measuring aerosol concentration; research on radioactive waste disposal; and calculations of airborne

hazards associated with postulated reactor catastrophes. (For preceding period see ORNL-1488.) (C.H.)

447

**Atomic Energy Project, Univ. of Calif., Los Angeles RECENT ATTEMPTS TO ALTER THE RESPONSE TO IONIZING RADIATIONS.** Wilbur A. Selle, George D. Mason, and Robert H. Newman. Sept. 15, 1953. 73p. Contract AT-04-1-GEN-12. (UCLA-264)

Previous reports reviewing literature dealing with attempts to alter the response of animals to ionizing radiations were published in 1949 (NEPA-1127-IER-21), and in 1951 (UCLA-176). The present report summarizes 118 additional papers published during the past eighteen months. Data, results, and comments are presented in tabular form. In addition to various biological and pharmacological agents tested for their capacity to raise the tolerance of tissues to radiations and procedures which alter the physiological state by modification of the external and internal environment, data are included from studies of the role of the animal's own normally functioning reticulo-endothelial system in defense against the effects of radiation. The present report includes additional subjects not previously reviewed. Among these are anesthetics, autonomic drugs, dietary factors, pituitary hormones, insulin, exercise, and several miscellaneous organic compounds. (auth)

448

**Atomic Energy Project, Univ. of Calif., Los Angeles INFLUENCE OF GANGLIONIC BLOCKING AGENTS ON SURVIVAL TIME IN RADIATED MICE.** Thomas J. Haley, John Heglin, and Eve McCulloh. Issued Oct. 16, 1953. 9p. Contract AT-04-2-GEN-12. (UCLA-269)

The ganglionic blocking drugs; Banthine, nicotine, Prantal, tetraethylammonium chloride, Su-1194, and Pendiomide Dibromide, in concentrations of 0.45, 0.9, 1.35, and 1.8  $\times 10^{-3}$  M, were administered intramuscularly daily to mice receiving 550-r acute whole-body x irradiation. None of these drugs significantly increased survival time or decreased total mortality. It was concluded that, although these drugs were not beneficial, they were not detrimental to survival after whole-body irradiation. (auth)

449

**Atomic Energy Project, Univ. of Calif., Los Angeles INFLUENCE OF WATER SOLUBLE VITAMIN E ON SURVIVAL TIME IN RADIATED MICE.** Thomas J. Haley, Eve F. McCulloh, and W. G. McCormick. Issued Nov. 2, 1953. 9p. Contract AT-04-2-GEN-12. (UCLA-271)

The injection of water-soluble vitamin E (25.5%  $\alpha$ -tocopherol) in daily doses of 0.5, 1.0, 2.0, and 3.18 mg/animal, prior to and throughout the post-irradiation period, did not benefit mice receiving 550 r acute whole-body x irradiation. The two higher doses significantly decreased both the ST<sub>50</sub> day and the day of total mortality indicating that these doses acted synergistically with the irradiation. (auth)

450

**COMPARATIVE PROTECTIVE EFFECT OF CYSTEINE AGAINST FAST NEUTRON AND GAMMA IRRADIATION IN MICE.** Harvey M. Patt, John W. Clark, and Howard H. Vogel, Jr. *Proc. Soc. Exptl. Biol. Med.* **84**, 189-93(1953) Oct.

Cysteine pretreatment has been shown to confer significant protection against the acute lethal effects of  $\gamma$  and fast neutron irradiation in mice. The protection observed with fast neutrons is, however, about half of that found with  $\gamma$  irradiation. The data presented support the concept of a true dose reduction in the sense that primary mechanisms are involved. The inverse relationship between protective efficiency and ionization density is comparable



to that noted for the oxygen effect and, for the present, may best be interpreted in terms of the spatial distribution of the radicals formed in water and their reactions. (auth)

#### RADIATION SICKNESS

451

TRANSFUSION OF SEPARATED LEUCOCYTES INTO IRRADIATED DOGS WITH APLASTIC MARROWS. G. Brecher, K. M. Wilbur, and E. P. Cronkite. Proc. Soc. Exptl. Biol. Med. **84**, 54-6(1953) Oct.

The feasibility of recirculating separated leucocytes has been demonstrated in dogs with complete bone marrow aplasia induced by x irradiation. The transfused granulocytes were shown to migrate to sites of infection. (auth)

#### RADIOGRAPHY

452

THE QUANTITATIVE ESTIMATION OF RADIOACTIVE ISOTOPES BY RADIOAUTOGRAPHY. N. J. Nadler. Am. J. Roentgenol. Radium Therapy Nuclear Med. **70**, 814-23 (1953) Nov.

The theory and methods of quantitative radioautography have been reviewed. The technique favored for most biological applications is that of grain counting. The two varieties of this method in use involve either counting all the developed grains of the radioautograph produced by a given structure, or taking into account only those grains of specific layers in a given area over the center of the source. The latter method is practical where the histological reactive structures are relatively microscopically large, such as in the case of thyroid follicles. The required formulas for the interpretation of density measurements have been theoretically established. The basic assumptions were experimentally tested, providing correction factors which finally yielded a relationship between the photographic density of the radioautographic density of the radioautographic image and the tissue concentration of radioiodine. (auth)

#### RADIOTHERAPY

453

Brookhaven National Lab.

A PORTABLE GAMMA RAY IRRADIATOR. L. G. Stang, Jr., G. Strickland, A. C. Rand, and G. Selvin. [nd] 7p. (BNL-1618)

A 135-c portable  $\text{Co}^{60}$   $\gamma$ -ray source on a mount which allows either a vertical or horizontal beam is described. Beam intensities varied from 64 to 84 r/hr at a distance of 5 ft from the source. Shielding and beam characteristics are discussed. A photograph of the assembly is included. (C.H.)

#### TOXICOLOGY STUDIES

454

Hanford Works

ABSORPTION OF PLUTONIUM FED CHRONICALLY TO RATS. 1. FRACTION DEPOSITED IN SKELETON AND SOFT TISSUES FOLLOWING ORAL ADMINISTRATION OF SOLUTIONS OF VERY LOW MASS CONCENTRATION. Joseph Katz, Harry A. Kornberg, and Herbert M. Parker. Aug. 10, 1953. 20p. Contract W-31-109-eng-52. (HW-28991)

The gastrointestinal absorption and deposition of Pu in bone and soft tissue of 160 rats after 517 low-level feedings of  $\text{Pu}^{238}$  were determined at doses that varied from 0.04 to 1.2 times the currently accepted maximum permissible concentration of Pu in drinking water. Within the 95% limits of confidence, the mean per cent total, soft tissue, and skeletal deposition was  $0.00261 \pm 0.00038$ ,  $0.00021 \pm$

$0.00010$ , and  $0.00234 \pm 0.00028$ , respectively for animals receiving Pu levels equivalent to 1.2 times the maximum permissible concentration. No significant decrease in skeletal Pu was observed over a period of 250 days following cessation of feedings. The concentration of Pu fed appeared to exert some effect on amount absorbed and deposited, but this is being further investigated. (auth)

#### TRACER APPLICATIONS

455

Brookhaven National Lab.

THE EFFECTS OF THYROXINE OR TRIIODOTHYRONINE ON THE CHICK THYROID IN THE PRESENCE OR ABSENCE OF TSH. C. J. Shellabarger and John T. Godwin. [nd] 17p. (BNL-1586)

Either thyroxine or triiodothyronine inhibited the expected response to thyroid-stimulating hormonal (TSH) of an increase in thyroid weight and thyroid cell height in the 2.5-day White Leghorn cockerel. Neither thyroxine nor triiodothyronine affected thyroid weight or cell height in birds that received no TSH. This was interpreted as evidence that thyroxine or triiodothyronine acts directly on the thyroid gland to inhibit its response to TSH. When  $\text{I}^{131}$  uptake was studied, neither thyroxine nor triiodothyronine interfered with uptake when given with TSH. These thyroid hormones suppressed radioiodine uptake in birds that received no TSH. This was interpreted as evidence that the pituitary secretes minute amounts of TSH which are sufficient to effect  $\text{I}^{131}$  collection, yet do not produce discernible changes in thyroid weight or cell height, and that this pituitary TSH secretion can be inhibited by either thyroxine or triiodothyronine. (auth)

456

Brookhaven National Lab.

PARTICIPATION OF THE OXIDATIVE PATHWAY IN YEAST RESPIRATION. Harry Beevers, Purdue Univ. and Martin Gibbs, Brookhaven National Lab. [1953] 8p. (BNL-1615)

Results are described from preliminary experiments to determine the mechanism of glucose breakdown in yeast respiration. Data indicate that at least some of the glucose molecules take the oxidative pathway. (C.H.)

457

Hanford Works

METABOLISM OF HYDROGEN ISOTOPES BY RAPIDLY GROWING CHLORELLA PYRENOIDOSA CELLS. Daniel Weinberger and John W. Porter. Sept. 1, 1953. 17p. Contract W-31-109-Eng-52. (HW-29193)

*Chlorella pyrenoidosa* cells have been grown in the presence of deuterium and tritium oxide, and the quantity of each of these isotopes incorporated into the whole cells, methanol-insoluble, ether-soluble, and methanol-soluble-ether-insoluble fractions has been determined. The quantity present has been recorded in terms of the per cent expected on the assumption of no isotope effect. It has been found that the cells incorporate deuterium approximately 50% as rapidly as H, and that they incorporate tritium 90% as rapidly as deuterium. Further, the extent of incorporation of tritium or deuterium by the enzymes involved in H transfer in the synthesis of lipids is significantly higher than the extent of incorporation by enzymes involved in the transfer of H in the synthesis of proteins, nucleic acids, and starch (methanol-insoluble fraction). (auth)

458

Atomic Energy Medical Research Project, Western Reserve Univ.

THE MEASUREMENT OF THE EARLY DISAPPEARANCE OF IODINATED ( $\text{I}^{131}$ ) SERUM ALBUMIN FROM CIRCULATING BLOOD BY A CONTINUOUS RECORDING



**METHOD.** Walter H. Pritchard, Thomas W. Moir, W. J. MacIntyre, and Scott R. Inkley. Issued Oct. 10, 1953. 22p. Contract W31-109-eng-78. (NYO-4021)

A method is described of determining accurately the disappearance rates of  $\gamma$ -emitting tagged material from the circulating blood in man by continuous counting upon a small external arterio-venous fistula. (auth)

459

Louisiana State Univ.

**STUDIES OF LIVER PHYSIOLOGY AND PATHOLOGY INVOLVING THE USE OF BROMSULFALEIN CONTAINING S<sup>35</sup>. FINAL REPORT.** Ralph W. Brauer, John S. Krebs, and Rita L. Pressottl. [1952?] 59p. Contract AT-(40-1)-230. (ORO-104)

## WASTE DISPOSAL

460

[Institute of Engineering Research], Univ. of Calif.  
**REMOVAL OF RADIOISOTOPES BY SEWAGE TREATMENT PROCESSES. PROGRESS REPORT NO. 2 COVERING THE PERIOD APRIL 1, 1952 TO MAY 31, 1953. CONCENTRATION OF RADIOISOTOPES BY ACTIVATED SLUDGE.** Warren J. Kaufman, Gerhard Klein, and Arnold E. Greenberg. May 31, 1953. 71p. Contract AT-11-GEN-10. (AECU-2730; Progress Report No. 2)

The application of the activated sludge process to the concentration of  $P^{32}$ ,  $I^{131}$ , and  $Sr^{90}$  was investigated. The radioelements, in the chemical form of the orthophosphate, iodide, and Sr ions, were added to synthetic sewage to provide simple radioactive wastes of known composition. Studies were carried out on both the batch and the continuous flow basis. Data are presented graphically and in tabular form. It was concluded that biological treatment methods have limited application to the concentration of mono- and divalent ionic radioelements from highly mineral wastes, but that biological treatment may find application as an adjunct to the chemical treatment of low level radioactive wastes containing organic pollutants. (For preceding period see AECU-2035.) (C.H.)

## CHEMISTRY

461

Wisconsin Univ.

**A SPECTROPHOTOMETRIC INVESTIGATION OF THE EQUILIBRIA EXISTING IN ACIDIC SOLUTIONS OF CHROMIUM(VI).** James Ying-peh Tong and Edward L. King. 1953. 25p. Contract AT(11-1)-64. (AECU-2701)

Acidic solutions of Cr(VI) are observed to exhibit significant deviations from Beer's Law. Measurements of the optical density of Cr(VI) solutions at the wave lengths 370, 380, 390, and 400 m $\mu$  enable one to determine the values of the equilibrium quotients for the reactions:  $2HCrO_4^- \rightleftharpoons Cr_2O_7^{2-} + H_2O$ ;  $H_2CrO_4 \rightleftharpoons H^+ + HCrO_4^-$ ;  $HCrO_4^- \rightleftharpoons H^+ + CrO_4^{2-}$ . At 25°C in  $HClO_4$ - $LiClO_4$  media of unit ionic strength, the values of the equilibrium quotients for these reactions are  $K_d = 98$ ,  $K_{11} = 1.21$ , and  $K_{22} = 0.85$ , respectively. The values of the dimerization quotient,  $K_d$ , have been determined as a function of the ionic strength; an extrapolation to zero ionic strength yields the value  $K_d^0 = 35.5$ . (auth)

462

Northwestern Univ.

**THE VAPOR PHASE PHOTOLYSIS OF METHYL CYCLO-PROPYL AND METHYL CYCLOBUTYL KETONES** (thesis).

Irwin Norman. June 1953. 234p. Contract AT(11-1)-89. (AECU-2748)

A quantitative investigation of the photolysis of pure methyl cyclopropyl and methyl cyclobutyl ketones in the wave length region 2654 to 2537 Å was conducted over a temperature range from 25 to 170°C and 60 to 250°C, respectively. The non-condensable gaseous products were analyzed with a mass-spectrometer and a microgas analyzer. The condensable products were identified by infrared and ultraviolet absorption techniques. The effect of cycloalkyl substituents on the mode of the photodecomposition of the ketones and the reactivity and stability of the cyclopropyl and cyclobutyl free radicals were determined. (J.S.R.)

463

Brookhaven National Lab.

**AN APPARATUS FOR DETERMINING GAS SOLUBILITIES: THE SOLUBILITY OF PHOSPHINE IN AQUEOUS SOLUTIONS.** Ralph E. Weston, Jr. [1953?] 11p. (BNL-1611)

Solubility of phosphine in  $H_2O$  and aqueous solutions was determined by measuring directly the concentration of gas in the saturated solution. The procedure is suitable for any condensable gas and can be used for a noncondensable gas by substitution of Toepler pumping for condensation to manipulate the gas in the vacuum line. A value of  $-2950 \pm 100$  cal/mole for the enthalpy of solution was obtained. The experiments at 297.5°K were carried out with an earlier modification of the apparatus in which equilibrium temperature was constant from run to run but was not accurately known. The value of 297.5°K was determined from the enthalpy of solution and the mean experimental value of  $\beta$  at the unknown temperature. Regardless of this uncertainty, the data show that  $\beta$  is independent of pressure, so that Henry's law is obeyed below 1 atm. The data obtained with NaCl solutions fit the Setchnekow equation  $\log(S^0/S) = k_s C_s$ , where  $S^0$  is the solubility in pure solvent,  $S$  is that in a solution with salt concentration  $C_s$ , and  $k_s$  is a constant which depends on the particular salt. The effect of acid and base on the solubility does not differ enough from the effect of inert electrolyte to be ascribed to acidic or basic properties of phosphine. (J.A.G.)

464

California Research and Development Co., Livermore  
**VAPOR PRESSURE CURVES FOR C, Ni, Fe, Cr, Mo, W, Cu, Ta, AND Al OVER THE PRESSURE RANGE FROM  $10^{-10}$  ATM TO 1 ATM.** A. R. Snider. Oct. 2, 1952. 11p. (CRD-T2B-171)

465

Low Temperature Lab., Western Reserve Univ.  
**SOME THERMODYNAMIC PROPERTIES OF METHANE ADSORBED ON RUTILE BETWEEN 80° AND 140°K.** E. L. Pace, E. L. Heric, and Kent S. Dennis. Issued Dec. 1, 1952. 26p. Contract AT(30-1)-824. (NYO-908)

466

Low Temperature Lab., Western Reserve Univ.  
**HEAT CAPACITIES OF MULTIMOLECULAR LAYERS OF METHANE ADSORBED ON RUTILE.** Kent S. Dennis, E. L. Pace, and Charles S. Baughman. Issued Dec. 1, 1952. 8p. Contract AT(30-1)-824. (NYO-909)

467

Pennsylvania State Coll.  
**STABILITIES OF COORDINATION COMPOUNDS. PROGRESS REPORT FOR THE PERIOD SEPTEMBER 1, 1952 TO MAY 31, 1953.** W. Conard Fernellus. June 1, 1953. 22p. Contract AT(30-1)-907. (NYO-3634)

A number of general statements about the relationships among formation constants for chelate complexes are made. The scope of the present work is indicated, and a list is given of the reports and articles published which describe the results in detail. (J.S.R.)



468

Pennsylvania State Coll.

STUDIES ON COORDINATION COMPOUNDS. 11. FORMATION CONSTANTS OF SOME COMPOUNDS OF ACETYLACETONE WITH TERVALENT IONS. Reed M. Izatt, W. Conard Fernelius, and B. P. Block. Oct. 26, 1953.

18p. Contract AT(30-1)-907. (NYO-3635)

Stepwise activity formation constants have been determined in water at 30° for the reaction of the acetylacetone ion with the trivalent ions of La, Ce, Pr, Nd, Sm, Eu, Y, Sc, In, and Fe (listed in order of increasing values of the first formation constants). All salts used were perchlorates except  $\text{La}(\text{NO}_3)_3$ . These determinations were made potentiometrically with a glass electrode and a saturated calomel electrode. In the case of Fe, a Pt electrode in the presence of  $\text{Fe}^{+3}$  and  $\text{Fe}^{+2}$  was used to measure  $\text{Fe}^{+3}$  activity, and a correction was made for the hydrolysis of the  $\text{Fe}^{+3}$  ion. Plots of the logarithm of the first formation constant vs. (1) electronegativities (in the cases of  $\text{Pr}^{+3}$ ,  $\text{Y}^{+3}$ ,  $\text{Sc}^{+3}$ ,  $\text{In}^{+3}$ , and  $\text{Fe}^{+3}$ ), (2) third ionization potential (in the cases of  $\text{La}^{+3}$ ,  $\text{Ce}^{+3}$ ,  $\text{Y}^{+3}$ ,  $\text{Sc}^{+3}$ ,  $\text{In}^{+3}$ , and  $\text{Fe}^{+3}$ ), and (3) atomic number (in the cases of  $\text{La}^{+3}$  and the rare earths) are straight lines. The correlation in the case of (1) is in agreement with relationships previously established for uni-, bi- and trivalent ions with dibenzoylmethane in 75 vol. % dioxane solution. (auth)

469

Yale Univ.

THE DIFFERENTIAL DIFFUSION COEFFICIENT OF RUBIDIUM CHLORIDE IN DILUTE AQUEOUS SOLUTION AT 25°. Herbert S. Harned and Milton Blander. Feb. 5, 1953. 9p. Contract AT(30-1)-1375. (NYO-3874)

The differential diffusion coefficient of  $\text{RbCl}$  between 0.001 and 0.01M concentrations at 25° has been determined by the conductometric method. Good agreement with the prediction of the Nernst-Onsager and Fuoss equations has been obtained. (auth)

470

Yale Univ.

ON THE THEORY OF THE POLAROGRAPHIC DIFFUSION CURRENT. 1. DIFFUSION OF SMALL AMOUNT OF LEAD ION IN SOLUTIONS OF VARIOUS SUPPORTING ELECTROLYTES. Jui Hsui Wang. Oct. 15, 1953. Contract AT(30-1)-1375. (NYO-3877)

The tracer-diffusion coefficients of Pb ion in aqueous  $\text{KCl}$  solutions of concentration from 0.02- to 4.0F and 0.1F  $\text{KCl} + 0.1\text{F HCl}$  solutions were determined. The effect of gelatin on the tracer-diffusion coefficient of Pb ion was examined. Theoretical values of the "diffusion current constant" were calculated from the measured tracer-diffusion coefficients by means of the Ilkovič, Strehlow-von Stackelberg, and Lingane-Loveridge equations and compared with experimental data. (auth)

471

Yale Univ.

ON THE THEORY OF THE POLAROGRAPHIC DIFFUSION CURRENT. 2. DIFFUSION OF SMALL AMOUNT OF ZINC ION IN SOLUTIONS OF VARIOUS SUPPORTING ELECTROLYTES. Jui Hsui Wang. Oct. 15, 1953. 10p. Contract AT(30-1)-1375. (NYO-3878)

The tracer-diffusion coefficients of  $\text{Zn}(\text{II})$  ion in aqueous  $\text{KCl}$  and  $\text{KNO}_3$  solutions of different concentrations have been determined. The variation of the tracer-diffusion coefficient with concentration of the supporting electrolyte in dilute solutions was compared with that predicted from Onsager's theory. The rapid increase of the tracer-diffusion coefficient of  $\text{Zn}(\text{II})$  ion in  $\text{KCl}$  solution with increasing salt concentration was interpreted on the basis of complex ion formation. Lastly, the tracer-diffusion coef-

ficient of  $\text{Zn}(\text{II})$  ion in 1.0F  $\text{NH}_4\text{OH} + 1.0\text{F NH}_4\text{Cl}$  solution was determined; the "diffusion current constant" in this solution was calculated from the measured tracer-diffusion coefficient by means of the Ilkovič, Strehlow-von Stackelberg, and Lingane-Loveridge equations and compared with experimental data. (auth)

472

Pittsburgh Univ.

MAGNESIUM-CADMIUM ALLOYS. PART 7. LOW TEMPERATURE HEAT CAPACITIES OF  $\text{MgCd}$ , AND  $\text{Mg}_3\text{Cd}$  AND A TEST OF THE THIRD LAW OF THERMODYNAMICS FOR THE  $\text{MgCd}$  SUPERLATTICE. L. W. Coffey, R. S. Craig, C. A. Krier, and W. E. Wallace. [July 1, 1953]. 13p. Contract AT(30-1)-647. (NYO-6162)

Heat capacities between 12 and 320°K are presented for alloys containing 24.98 and 74.98 at. % Cd. These data are used to calculate entropies at 25° relative to absolute zero. From these results and additional data in the literature the residual entropy of  $\text{MgCd}$  has been computed to be 0.23 eu/g-atom. This has been accounted for in terms of frozen-in Schottky defects, which at 25° are present to 1.7%. The measured heat capacities deviate appreciably from the values expected from the Kopp-Neumann rule. The experiments have revealed a broad solid-state transition in  $\text{Mg}_3\text{Cd}$  beginning at about the ice point and one or possibly two such transitions in  $\text{MgCd}$ , between 182 and 320°K. (auth)

473

Atomic Energy Project, Univ. of Rochester

SOLUBILITY STUDIES OF SYNTHETIC HYDROXYLAPATITE. (THE LATTICE OF BONE MINERAL). George J. Levinskis. Sept. 14, 1953. 134p. Contract W-7401-eng-49. (UR-273)

The solubility of synthetic hydroxylapatite was investigated under widely varying conditions in carbon dioxide-free salt solutions of the same ionic strength as plasma. The reproducibility of the results and the agreement of solubility findings when undersaturated and supersaturated solutions were employed initially are evidence of the attainment of equilibrium in the studies performed. Even under rigorously controlled conditions, the presumably constant, well-characterized solid phase employed in these investigations does not follow the laws of solubility for sparingly soluble compounds. It is impossible to determine a  $K_{sp}$  for such examples of the apatite lattice in aqueous systems. The behavior of hydroxylapatite in this study strengthens the view that substances with an apatite structure are solid solutions. 125 references. (auth)

474

Atomic Energy Project, Univ. of Rochester

EVIDENCE FOR COMPLEX-ION FORMATION IN THE CALCIUM: BICARBONATE SYSTEM. W. F. Neuman, H. C. Hodge, P. E. Morrow, and T. Y. Toribara. Sept. 8, 1953. 12p. Contract W-7401-eng-49. (UR-275)

Ion-exchange studies employing radiocalcium and ultrafiltration of bovine sera have furnished evidence of complex ion formation in the Ca: bicarbonate system. The complex ion has not been fully characterized, but it has been shown to be so highly dissociated that only an insignificant fraction of the Ca in serum can be bound as a bicarbonate under physiological conditions. (auth)

475

NICKEL AND CHROMIUM PLATING OF TUNGSTEN

FILAMENTS. V. D. Polyakov [Poliakov]. Translated from Zhur. Priklad. Khim. 9, 1033-7(1936). 9p. (AEC-tr-1704)

A method was devised for the galvanic electroplating of a W filament with Ni and Cr for the purpose of protecting it against dispersal. An anode of pure French Ni was used. An electrolyte solution of  $\text{NiSO}_4$  and citric acid neutralized with  $\text{NaOH}$  gave excellent results, particularly when the



experiment was carried out on a reinforced filament in quiescent conditions at a current of 0.01 amp, leaving it under current for 21 hr. The good performance of this bath was explained by the presence of Na citrate, supporting a small concentration of H ions. Chromium plating proceeded with the same results on either Ni-plated or unplated W filaments. However, the thicker the layer the more brittle and incapable of bending it became. (J.A.G.)

- 476 THE MECHANISM OF THE OXIDATION REACTION OF PROPANE PHOTOCHEMICALLY SENSITIZED WITH MERCURY AT LOW TEMPERATURES. N. V. Fok and A. B. Nalbandyan. Translated by Richard B. Mudge from Doklady Akad. Nauk S.S.S.R. 86, 589-92(1952). 10p. (TT-396)

- 477 THE BEHAVIOR OF THE SILVER-SILVER SULFATE AND THE MERCURY-MERCUROUS SULFATE ELECTRODES AT HIGH TEMPERATURES. M. H. Lietzke and R. W. Stoughton. J. Am. Chem. Soc. 75, 5226-7(1953) Nov. 5.

In an attempt to develop a high temperature reference electrode, a series of measurements of the potential of the Ag-Ag<sub>2</sub>SO<sub>4</sub> and Hg-Hg<sub>2</sub>SO<sub>4</sub> electrode combination has been made. In these experiments the temperature was varied from 25 to 250° and the acid concentration from 0.5 to 0.05M H<sub>2</sub>SO<sub>4</sub>. The potentials obtained at given temperatures were compared with those predicted on the basis of thermodynamic calculations for the cell combination used. A possible explanation is given for the high temperature behavior of the Ag-Ag<sub>2</sub>SO<sub>4</sub> and Hg-Hg<sub>2</sub>SO<sub>4</sub> electrode pair. (auth)

- 478 THE HEAT CAPACITY AND ENTROPY OF THORIUM FROM 18 TO 300°K. Maurice Griffel and Richard E. Skochdopole. J. Am. Chem. Soc. 75, 5250-1(1953) Nov. 5.

The heat capacity of Th has been measured from 18 to 300°K and tabulated along with entropy, enthalpy, and Gibbs function as a function of temperature. The entropy, excluding spin and nuclear effects, is 12.76 cal/deg. at 298.16°K. (auth)

- 479 ABSOLUTE ENTROPIES IN LIQUID AMMONIA. Wendell M. Latimer and William L. Jolly. J. Am. Chem. Soc. 75, 4147-8(1953) Sept. 5.

It is shown that a simple relationship exists between the partial molal entropies of ions in water and liquid ammonia if the absolute entropy of H<sup>+</sup> is taken as -2 e.u. in water and -25 e.u. in ammonia. A new tabulation of thermodynamic data for ions in liquid ammonia is given. (auth)

- 480 POLYMORPHISM OF SODIUM SUPEROXIDE. Giles F. Carter and D. H. Templeton. J. Am. Chem. Soc. 75, 5247-9(1953) Nov. 5.

The structures of NaO<sub>2</sub> have been studied by powder and single x-ray-diffraction methods at low temperatures. NaO<sub>2</sub>(I), stable above -50°, has a disordered pyrite structure, with a = 5.49 Å at 25°. The disorder probably is dynamic. NaO<sub>2</sub>(II) exists from -50 to -77° with the pyrite structure, with a = 5.46 Å at -70°. The O<sub>2</sub> parameter is u = 0.43. NaO<sub>2</sub>(III) exists below -77° with the marcasite structure, space group Pnnm, with a = 4.26 Å, b = 5.54 Å, and c = 3.44 Å at -100°. The O<sub>2</sub> parameters are x = 0.12 and y = 0.43. (auth)

#### ANALYTICAL PROCEDURES

- 481 Ames Lab.  
INNER-COMPLEX COMPOUNDS OF ALICYCLIC VIC-DIOXIMES. Roger C. Voter and C. V. Banks. June 1951. 69p. Contract W-7405-eng-82. (ISC-230)

The preparation and possible uses of some vic-dioximes as an analytic reagent for Ni<sup>++</sup> and Pd<sup>++</sup> were investigated. An infrared spectroscopic study was made of the nature of the H bonds in these compounds. 1,2-Cyclopentanedione dioxime was prepared by the oximation of 1,2-cyclopentanedione. It showed no promise as an analytical reagent because of the narrow pH range over which the Ni compound was insoluble. 1,2-Cyclohexanedione dioxime can be used as a gravimetric reagent for Pd, but it was completely unsatisfactory for the determination of Ni in the presence of Fe. The synthesis of 1,2-cycloheptanedione by SeO<sub>2</sub> oxidation of cycloheptanone and of 1,2-cycloheptanedione dioxime by oxidation of the dione were described. The dioxime precipitated Ni in the presence of large quantities of Fe, but Pt interfered with its precipitation of Pd. 1,2-Cyclodecanedione and 1,2-cyclodecanedione dioxime were prepared, but showed no value as an analytic reagent for Ni<sup>++</sup> or Pd<sup>++</sup>. The infrared absorption spectra of d<sub>2</sub>-labeled and unlabeled 1,2-cyclohexanedione dioxime, 1,2-cycloheptanedione dioxime, and 2,3-butanedione dioxime and of their Ni(II) and Pd(II) derivatives were obtained. It was suggested that an atomic arrangement of 1,2-bis(vic-dioximo-N,N')Ni(II) compounds in which the oxime hydrogens are located midway between the two O atoms is possible. (J.S.R.)

- 482 Ames Lab.  
DIRECT TITRIMETRIC DETERMINATION OF SULFATE. James S. Fritz and Max Q. Freeland. Oct. 1, 1953. 13p. Contract W-7405-eng-82. (ISC-411)

The method proposed involves direct titration of sulfate with standard Ba solution. Alizarin Red S serves as the indicator, giving a sharp, vivid change from yellow to pink at the end point. The titration is carried out in 30 to 40% alcohol, since no end point is observed in H<sub>2</sub>O alone. Equilibrium is quickly attained, permitting a rapid titration. Coprecipitation errors are greater than for gravimetric sulfate methods, but most of these can be avoided by the preliminary removal of cations with an ion exchange column. The simple titrimetric procedure should be useful in many cases where a rapid approximation of sulfate is required. In the absence of interfering anions, the ion exchange-titrimetric method is equally as precise as the gravimetric method and is considerably faster. (auth)

- 483 Ames Lab.  
THE DETERMINATION OF MESOTHORIUM IN THORIUM NITRATE. M. Allison, R. W. Moore, A. E. Richardson, D. T. Peterson, and A. F. Voigt. Nov. 4, 1953. 13p. Contract W-7405-eng-82. (ISC-417)

A method is described for determining the amount of Ra<sup>228</sup> (MsTh<sub>1</sub>), the 6.7-yr daughter of Th<sup>232</sup>, present in Th. The method is rapid, reproducible, and accurate. (auth)

- 484 Picatinny Arsenal  
AN EVALUATION OF MICROANALYTICAL METHODS FOR THE DETERMINATION OF NITROGEN, SULFUR, CHLORINE AND BROMINE IN ORGANIC COMPOUNDS. J. Lavitt, B. Banks, and I. Kolier. Oct. 17, 1952. 41p. (PA-1894; ATI-172720; Report 1)

The microanalytical methods used in this investigation for the determination of N<sub>2</sub> (micro-Dumas method), halogen, and S (Carius method and catalytic combustion method) are given in detail and evaluated. A summary of the statistical evaluation of the results obtained by the methods is given. The results indicate that (1) the micro-Dumas method is satisfactory for the determination of N<sub>2</sub>, (2) the Carius method is satisfactory for the determination of halogens and S, (3) the catalytic combustion method is satisfactory



for the determination of S and Cl, and (4) in view of the relatively great dispersion of values obtained for the determination of Br in p-bromoacetanilide by the catalytic combustion method, as reflected in the wide range and high estimated standard deviation given above, the method should be applied to the determination of Br only with some degree of discretion. (auth)

485

APPARATUS FOR THE DETERMINATION OF IMPURITIES IN INERT GASES. P. Z. Burbo. Translated by R. R. Kepple from *Zavodskaya Lab.* 16, 1498-1500(1950). 4p. (AEC-tr-1685)

An apparatus is described for the determination of impurities in inert gases, based on the absorption of ordinary impurities that usually accompany rare gases by molten metallic Li under a pressure of 450 to 500 mm Hg and at a temperature of 180 to 200°C. This method of analysis permits the determination of greater than 0.1 to 0.2% by volume of impurities in A. (J.A.G.)

#### CRYSTALLOGRAPHY AND CRYSTAL STRUCTURE

486

Iowa State Univ.  
THE CRYSTAL STRUCTURES OF ZrBeSi AND ZrBe<sub>2</sub>. J. W. Nielsen and N. C. Baenziger. [1953?] 5p. Contract AT(11-1)-72. (AECU-2728)

The composition of ZrBeSi crystals was determined from x-ray-diffraction data and a few qualitative chemical tests. Synthesis of the compound further verified its composition. Zero to fourth layer Weissenberg diagrams using Cu K radiation were obtained from one of the crystals, and the dimensions of the hexagonal cell were determined from a powder diagram. The interatomic distances and the comparison of calculated and observed intensities are given. The compound ZrBe<sub>2</sub> has been prepared and found from powder diagrams to have the Al boride structure. The interatomic distances of ZrBe<sub>2</sub> are also given. (J.A.G.)

487

Brookhaven National Lab.  
ON THE THEORY OF DEFECT CONCENTRATION IN CRYSTALS. G. H. Vineyard and G. J. Dienes. [1953] 13p. (BNL-1607)

The theory of the formation of vacancy and interstitial defects in crystals is re-examined. It is suggested that a Born-von Karman type of lattice provides an adequate model for the calculation of the essential parameters giving the concentration of defects as a function of temperature. It is concluded that the entropy of formation depends only on the lattice frequencies before and after formation of the defect, and no further contribution to the entropy arises even though the enthalpy of formation may appear to remain temperature dependent at constant pressure. Data on vacancy concentration in NaCl and LiF are analyzed roughly in the light of present ideas. The results for NaCl are understandable in a simple way; those for LiF seem to require more complete calculations. (auth)

488

Cornell Univ.  
STRUCTURES OF FLUOROCARBONS, ELEMENTARY BORON, AND BORON COMPOUNDS. [SUMMARY REPORT FOR JUNE 15 TO OCTOBER 1, 1953]. J. L. Hoard. Oct. 1, 1953. 6p. Contract AT(30-1)-878. (NYO-3945)

All (hh $\nu$ ) intensity data obtainable with MoK $\alpha$  radiation from a single crystal of tetragonal B have been measured on our spectrometer. These data are being used with the aid of the least squares method to give the remaining (z-) atomic coordinates of B atoms within the unit cell. Some further evidence is presented that individual crystals of tetragonal B show structural variations depending on the

concentration of extra B in holes in the ideal framework. The second plate-like modification of B is monoclinic with aspects of pseudo-threefold symmetry. An approximate though not certainly primitive unit has  $a = 10.0$ ,  $b = 17.8$ ,  $c = 8.8$  Å, and  $\beta \approx 90^\circ$ . Such a unit contains about 200 B atoms and shows a striking dimensional relationship to the unit of tetragonal B. A special report on fluorocarbons showing molecular rotation in the crystals has been prepared. Little progress with other studies of fluorocarbons can be reported. (For preceding period see NYO-3944.) (auth)

#### DEUTERIUM AND DEUTERIUM COMPOUNDS

489

National Bureau of Standards  
A REVIEW OF THE PROPERTIES OF DEUTERIUM COMPOUNDS. BIBLIOGRAPHY OF UNCLASSIFIED GOVERNMENT REPORTS: 1947-1952. L. M. Brown and A. S. Friedman. 160p. (NBS-2492)

A bibliography of unclassified federal government reports pertaining to research on the isotopes of H and their compounds has been compiled largely from *Nuclear Science Abstracts*, *Abstracts of Declassified Documents*, and the *Technical Information Pilot*. It consists of 943 references and covers the period 1947 to Nov. 1952. The entries in the bibliography are arranged alphabetically by leading author and contain code symbols designating the subject matter involved. Author, subject, and compound indexes are also included. (auth)

490

THE HYDROGEN-DEUTERIUM EXCHANGE REACTION ON ZINC OXIDE CATALYSTS. E. Molinari and G. Parravano. *J. Am. Chem. Soc.* 75, 5233-7(1953) Nov. 5.

The H<sub>2</sub>-D<sub>2</sub> exchange reaction was investigated on ZnO samples, whose semiconductivity was modified by the introduction of foreign cations into the ZnO lattice. The reaction follows kinetically two stages. During the first stage, characterized by increasing activity at constant temperature, the catalytic surface is being formed. The effect of pre-adsorbed O<sub>2</sub> on this stage is emphasized. During the second stage the catalytic activity and the activation energy of the reaction are affected by foreign additions to ZnO. The cation-anion ratio in ZnO determines the sign of the change in activity. (auth)

#### FLUORINE AND FLUORINE COMPOUNDS

491

New Hampshire Univ.  
THE REACTION OF FLUORINE WITH COPPER AND SOME OF ITS COMPOUNDS. SOME PROPERTIES OF COPPER (II) FLUORIDE. H. M. Haendler. Oct. 21, 1953. 13p. Contract AT(30-1)-827. (NYO-6121)

The reaction of F with Cu, Cu<sub>2</sub>O, CuO, Cu<sub>2</sub>S, CuS, and CuSO<sub>4</sub> has been investigated. CuF<sub>2</sub> was the only non-volatile product observed except in the case of Cu<sub>2</sub>O, in which CuO was also found in the product. CuF<sub>2</sub> does not have the cubic fluorite structure, as reported, but is monoclinic. The density of CuF<sub>2</sub> has been determined as  $4.85 \pm 0.05$  g/cc. CuF<sub>2</sub> is volatile and melts in a He atmosphere at  $785 \pm 10^\circ$ . Thermal analysis indicates changes in CuF<sub>2</sub> at 770, 780, and about 900° which are believed to involve decomposition of the fluoride. (auth)

492

New Hampshire Univ.  
THE REACTION OF FLUORINE WITH TIN, ITS OXIDES AND SULFIDES. H. M. Haendler. Oct. 28, 1953. 5p. Contract AT(30-1)-827. (NYO-6122)

A study has been made of the action of F on Sn, SnO, SnO<sub>2</sub>, SnS, and SnS<sub>2</sub>. SnF<sub>4</sub> was the only F-containing



product observed.  $\text{SnO}$  is converted to  $\text{SnO}_2$  during the fluorination. (auth)

**493**  
New Hampshire Univ.  
THE REACTION OF FLUORINE WITH TITANIUM, ZIRCONIUM AND THE OXIDES OF TITANIUM (IV), ZIRCONIUM (IV) AND VANADIUM (V). H. M. Haendler. Oct. 30, 1953. 6p. Contract AT(30-1)-827. (NYO-6123)

F converts Ti and  $\text{TiO}_2$  to the tetrafluoride at  $350^\circ$ . Zr and  $\text{ZrO}_2$  react to form  $\text{ZrF}_4$ .  $\text{V}_2\text{O}_5$  forms  $\text{VOF}_3$  with F. (auth)

**494**  
Oak Ridge National Lab.  
A METHOD FOR THE DETERMINATION OF WATER IN FLUORIDE SALTS. W. J. Ross and J. C. White. Sept. 8, 1953. 19p. Contract W-7405-eng-26. (ORNL-1618)  
The removal of water by extraction with xylene and its subsequent determination by titration with Karl Fischer reagent has been successfully adapted to the determination of traces of water in alkali metal fluorides. The method was also applied to the determination of water in other solids containing larger concentrations of water. It is of particular value for the determination of water in thermally unstable solids. If a large sample (10 to 20 g) is used, the limit of determination is of the order of 0.01%. (auth)

**495**  
Research Inst., Univ. of Okla.  
SPECTROSCOPIC PROPERTIES OF FLUOROCARBONS AND FLUORINATED HYDROCARBONS. PROGRESS REPORT NO. 3. J. Rud Nielsen. June 15, 1953. 285p. Contract AT-40-1-1074. (ORO-105)  
New Raman irradiation apparatus for liquids and for crystal powders and an improved Raman tube for gases were built. The Raman spectra of gaseous  $\text{CF}_4$ ,  $\text{CF}_3\text{Cl}$ ,  $\text{CF}_2\text{Cl}_2$ ,  $\text{CFCl}_3$ ,  $\text{CCl}_4$ ,  $\text{CF}_2\text{H}_2$ , and  $\text{C}_2\text{F}_6$  and of liquid  $\text{CF}_2\text{Br}_2$ ,  $\text{CCl}_2\text{CFCl}$ , and hexafluorane were investigated. The infrared spectra of gaseous and liquid  $\text{CCl}_2\text{CFCl}$  were obtained. The vibrational spectra and calculated thermodynamic properties of  $\text{CF}_3\text{CF}_2\text{Cl}$ ,  $\text{CF}_3\text{CFCl}_2$ ,  $\text{CF}_3\text{CCl}_3$ ,  $\text{CF}_3\text{CH}_2\text{Cl}$ ,  $\text{CF}_3\text{CHCl}_2$ ,  $\text{CCl}_3\text{CF}_2\text{Cl}$ ,  $\text{CCl}_3\text{CFCl}_2$ ,  $\text{CH}_3\text{CH}_2\text{Cl}$ ,  $\text{CH}_3\text{CHCl}_2$ ,  $\text{CCl}_3\text{CH}_2\text{Cl}$ , and  $\text{CCl}_3\text{CHCl}_2$  were given. A normal coordinate analysis based on a Urey-Bradley potential function was made of  $\text{CF}_3\text{CH}_3$ . The normal coordinate analyses of certain species of vibrations of 1,3,5-trifluorobenzene and some of the less symmetrical fluorobenzenes, complete assignments of fundamental vibrational frequencies for fluorobenzene, 1,4- and 1,3-difluorobenzene, 1,2,4-trifluorobenzene, 1,2,4,5-tetrafluorobenzene, p-fluorotoluene, and 1,4-bis(trifluoromethyl)benzene, and detailed interpretation of the infrared and Raman spectra of these compounds were reported. Some interesting and useful regularities in these spectra were found. (auth)

**496**  
SOLUBILITY OF SOME METAL FLUORIDES IN BROMINE TRIFLUORIDE. Irving Sheft, Herbert H. Hyman, and Joseph J. Katz. *J. Am. Chem. Soc.* **75**, 5221-3(1953) Nov. 5.

The solubility of a number of the metal fluorides in  $\text{BrF}_3$  has been determined at  $25^\circ$  and at  $70^\circ$ . These solubilities are compared with solubilities in water and anhydrous HF. The data are correlated by considering the behavior of these fluorides as fluoride ion donors or acceptors. The ability to donate or accept fluoride ions is related to the position of the element in the periodic table and especially to its oxidation state, and enables the solubility characteristics of the metal fluorides to be readily systematized. (auth)

## RADIATION CHEMISTRY

**497**  
Brookhaven National Lab.  
TEMPERATURE COEFFICIENT OF THE RADIATION INDUCED OXIDATION OF FERROUS SULFATE. Harold A. Schwarz. [1953] 5p. (BNL-1616)

The temperature coefficient of the radiation-induced oxidation of  $\text{FeSO}_4$  was determined in the range from 3 to  $72^\circ\text{C}$ . The coefficient was found to be  $0.04 \pm 0.03\%/^\circ$ . Three possible reasons for the temperature dependence are given. (J.S.R.)

**498**  
STUDIES IN LOW CONCENTRATION CHEMISTRY. IV. THE RADIOCOLLOIDAL PROPERTIES OF BERYLLIUM. George K. Schweitzer and James W. Nehls. *J. Am. Chem. Soc.* **75**, 4354-6(1953) Sept. 5.

The radiocolloidal properties of Be were investigated with  $\text{Be}^+$  as a tracer. The coagulation time at pH values of 8.0, 9.0, and 10.0 is approximately 5 min. At about a pH of 9 and above, 70 to 80% of the Be is removed. The addition of  $\text{NaNO}_3$ ,  $\text{NaCl}$ ,  $\text{NaBr}$ ,  $\text{NaHCO}_3$ , or  $\text{Na}_2\text{SO}_4$  causes the percentage of Be removed to decrease. The effect of the composition of the solvent upon the percent of Be removed is graphed. Stirring appears to decrease the amount of Be removed. With increase of pH, the diffusion coefficients of Be decreased. (J.S.R.)

## RADIATION EFFECTS

**499**  
Illinois Univ.  
STUDIES OF EFFECTS OF HIGH ENERGY RADIATION ON CHEMICAL SYSTEMS. BIMONTHLY PROGRESS REPORT NO. 6 [FOR] APRIL 15, 1952 TO JUNE 15, 1952. G. L. Clark, P. E. Bierstedt, and J. O. Gardner. 16p. Contract DA-18-108-CML-2446. (ATI-155679; U-22766)

**500**  
THE CHEMICAL EFFECTS OF PENETRATING RADIUM RAYS. 4. THE INFLUENCE OF PENETRATING RAYS ON SOME ORGANIC COMPOUNDS AND REACTIONS. A. Kailan. Translated from *Monatsh. Chem.* **33**, 1361-77 (1912). 10p. (AERE-Trans-11/3/5/378)

The velocity of esterification of benzoic acid, catalyzed by alcoholic HCl is not affected either in absolute or in aqueous alcohol by the penetrating Ra rays; from this it may be concluded that the rays cannot exert any effect on the degree of dissociation of the alcoholic HCl. The acid formation from orthonitrobenzaldehyde taking place under the action of light is accelerated both in alcoholic and in benzene solution by the penetrating Ra rays. The velocity of acid formation brought about by about 90 mg Ra carbonate is about 10,000 to 20,000 fold less than that produced by a Hg lamp at 8 cm. The velocity of acid formation increases hardly appreciably with increasing aldehyde concentration. Neither in an ether nor in an alcoholic solution of quinone can there be detected any effect from the penetrating rays of 100 mg  $\text{RaCl}_2$  or any acceleration of the reaction which occurs in light. Under the experimental conditions and in the course of about 1000 hr no effect of the penetrating rays from 100 to 200 mg of Ra salt on normal oxalic acid solution at  $25^\circ\text{C}$  could be established with certainty. In unsterilized, initially neutral sugar solutions, the decrease in rotatory power was accelerated by the penetrating rays. The velocity of this decrease appeared to increase with increasing duration of experiment. The decrease of rotatory power corresponded approximately to the inversion which could be produced by the amount of acid titrimetrically estimated at the end of an experiment. In contrast to the germicidal action of ultraviolet rays, the penetrating Ra



rays appeared under the experimental conditions to favor mold growth in the sugar solutions. (auth)

# SEPARATION PROCEDURES

501

Argonne National Lab.

PART 1. (EXPERIMENTAL). SEPARATION OF CATIONS BY AN ELECTROGRAVITATIONAL METHOD. PART 2. (THEORETICAL). A. EQUIVALENT CIRCUIT MODEL OF THE TRANSFERENCE CELL. B. THE TRANSFERENCE CELL: THERMODYNAMICS OF THE STEADY STATE. George W. Murphy. Jan. 1953. 66p. Contract W-31-109-eng-38. (ANL-5104)

Because of the difference in mobility of two or more cations in solution, electrogravitational separations appear feasible. The NaCl-KCl binary mixture was first tested to study all the variables, and it was found that the separation offered promise for practical application. An attempt to separate  $\text{Li}^6$  and  $\text{Li}^7$  was unsuccessful as the method does not have sufficient resolving power. As hydrolysis and subsequent precipitation prevent the maintenance of a constant pH, Ce and Th can not be fractionated. Ra and Ba can be satisfactorily separated under carefully controlled conditions. The apparatus is described briefly. Part II-A of this report has been abstracted and indexed as AECU-2378 and appeared in *Nuclear Science Abstracts* as NSA 7-1607. The thermodynamic equations for the steady state conditions of a cell were developed. It was shown that emf measurements made on a cell in steady state will yield the difference in chemical potential of the electrodes directly. (J.S.R.)

502

Brookhaven National Lab.

PAPER CHROMATOGRAPHY OF CHLOROPHYLLS. Alfred H. Sporer, Simon Freed, and Kenneth M. Sancier. [1953?] 2p. (BNL-1603)

A method is described for the chromatographic separation of chlorophylls, in which paper impregnated with sucrose and a developer consisting of 0.5% *n*-propyl alcohol in *n*-hexane were used. The method is said to avoid the decomposition of chlorophylls which occurs when they are subjected to paper chromatography. (C.H.)

503

Oak Ridge National Lab.

THE SEPARATION FACTOR. A CRITERION FOR EVALUATION OF FRACTIONAL SEPARATION PROCESSES. Boyd Weaver. Issued Nov. 10, 1953. 10p. Contract W-7405-eng-26. (ORNL-1627)

It is suggested that, in reporting the results of research on fractional separation of a pair of similar elements, more use should be made of the "separation factor" as a criterion for determining the effectiveness of a single stage in a division of a mixture into two fractions. The "separation factor" is the ratio between two elements in one fraction divided by their ratio in the other fraction. It is independent of the original composition and of the extent of the separation process. The literature dealing with separation of the Hf-Zr pair and the rare earth group has been surveyed as a means of evaluating separation methods. Separation factors have been calculated and compiled from the small amount of useful data. This criterion has been applied usefully in development of a separation process by the author. (auth)

504

STUDIES ON THE EXTRACTION OF METAL COMPLEXES. VIII. THE EXTRACTION OF La, Sm, Hf, Th, AND U(VI) WITH OXINE AND CUPFERRON. David Dyrssen and Viktoria Dahlberg. *Acta Chem. Scand.* 7, No. 8, 1186-96 (1953). (In English)

The solvent partition of the oxinates and cupferrons of La(III), Sm(III), Hf(IV), Th(IV), and U(VI) between an aqueous phase and chloroform or hexone was discussed. The ionic strength of the aqueous phase was kept constant at 0.1M with  $\text{HClO}_4$ ,  $\text{NaClO}_4$ , and NaOH. All experiments were carried out at 25°C. Curves were given showing the partition of the metals between the organic phase and the aqueous phase as a function of the oxinate or cupferron ion concentration. (J.S.R.)

# SPECTROSCOPY

505

Michigan Univ.

POLAROGRAPHIC BEHAVIOR OF GLYOXAL. Philip J. Elving and C. Eugene Bennett. Aug. 25, 1953. 22p. Contract AT(11-1)-70, Technical Report No. 7. (COO-183)

Glyoxal gives one polarographic wave in the pH range of 7.0 to 12.4 except in  $\text{NH}_3$  buffers where an additional wave appears. The waves are kinetically controlled which eliminates use of the Ilkovic equation for calculating the number of electrons involved in the electrode process. Coulometric runs in McIlvaine buffer at pH 7.0 and modified coulometric runs in phosphate buffer at pH 10.4 indicate that about three electrons are transferred per molecule of glyoxal, which is believed to indicate the average number of electrons involved in the formation of several products. Evidence is presented for the electrode process involving a free radical mechanism. The major process is probably the reduction of glyoxal to glycolic aldehyde followed by the reduction of the aldehyde to ethylene glycol, erythritol, or both; the two waves merge into one because of the closeness of their  $E_{1/2}$  values. The earlier wave in  $\text{NA}_3$  buffer is due to imine formation. By using carefully standardized conditions, glyoxal can be determined polarographically. (auth)

506

Spectroscopy Lab., Mass. Inst. of Tech.

THE INFRARED SPECTRA OF MONOCHLOROGERMANE AND MONOCHLOROGERMANE- $\text{D}_3$ ; SYNTHESIS AND SPECTROSCOPIC STUDY OF SIMPLE HYDROCARBONS AND THEIR DEUTERIUM DERIVATIVES. R. C. Lord and C. M. Steese. Oct. 15, 1953. 30p. Contract DA-19-020-ORD-896. (NP-4909; Technical Report 4)

Infrared absorption spectra of  $\text{GeH}_3\text{Cl}$  and  $\text{GeD}_3\text{Cl}$  have been observed and the fundamentals located at 2121.2, 847.7, 422.6  $\text{cm}^{-1}$  (parallel) and 2129.4, 874.6, 604.1  $\text{cm}^{-1}$  (perpendicular) in  $\text{GeH}_3\text{Cl}$ , and at 1522, 614, 421  $\text{cm}^{-1}$  (parallel) and 1530, 630, 434  $\text{cm}^{-1}$  (perpendicular) in  $\text{GeD}_3\text{Cl}$ . Analysis of the rotational structure of the perpendicular bands in  $\text{GeH}_3\text{Cl}$  leads to these values of the rotational constants:  $A''$ , 2.603  $\text{cm}^{-1}$ ;  $\zeta_4$ , -0.059;  $\zeta_5$ , -0.124;  $\zeta_6$ , +0.209. Agreement with microwave  $A''$  is satisfactory. Thermodynamic quantities are computed for  $\text{GeH}_3\text{Cl}$  and  $\text{GeD}_3\text{Cl}$ . The rotation-vibration spectrum of  $\text{GeH}_3\text{Cl}$  as resolved by a prism instrument is reported, along with the vibrational spectrum of the D analogue,  $\text{GeD}_3\text{Cl}$ . (auth)

# SYNTHESES

507

National Bureau of Standards

PREPARATION OF D-GALACTOSE-1- $\text{C}^{14}$  AND D-TALOSE-1- $\text{C}^{14}$ . Horace S. Isbell, Harriet L. Frush, and Nancy B. Holt. Sept. 28, 1953. 13p. (NBS-2821)

A study was made of the mode of synthesis of  $\alpha$ -D-galactose-1- $\text{C}^{14}$  and  $\alpha$ -D-talose-1- $\text{C}^{14}$  by means of techniques previously described in order to make the compounds available for tracer techniques in biological systems and to facilitate preparation. A diagram of the method of synthesis is given. (J.E.D.)



## TRACER APPLICATIONS

508

**MOLECULAR REARRANGEMENTS. I. THE 1,2,2-TRIPHENYLETHYL SYSTEM.** William A. Bonner and Clair J. Collins. *J. Am. Chem. Soc.* **75**, 5372-9(1953) Nov. 5.

1,2,2-Triphenylethanol-1- $C^{14}$ (I) has been acetylated and the acetate(II) deacetylated with no radiochemical rearrangement. When I was dehydrated with phosphoric anhydride in xylene, the resulting 1,1,2-triphenylethylene-1,2- $C^{14}$ (III) has an equal distribution of radioactivity in the ethylenic carbons. Similarly, when one mole of II was warmed in glacial acetic acid containing a mole of *p*-toluenesulfonic acid, the reisolated acetate contained an equal amount of  $C^{14}$  in each ethylenic position. This rearrangement of II was not observed when Na acetate was present in the reaction mixture. Formolysis of the tosylate (IV) of I proceeded with elimination, yielding III in which a net 50% phenyl migration had taken place. Acetolysis of IV proceeded with 39% phenyl migration, whereas hydrolysis of IV in aqueous acetone proceeded with 22% phenyl migration. The  $LiAlH_4$  reduction of IV was attended by 9% phenyl migration. These results are discussed in terms of the presumed symmetrical phenonium ion intermediates. (auth)

509

**MOLECULAR REARRANGEMENTS. II. THE 1,1,2-TRIPHENYLETHYL SYSTEM.** Clair J. Collins and William A. Bonner. *J. Am. Chem. Soc.* **75**, 5379-81(1953) Nov. 5.

1,1,2-Triphenylethanol-1- $C^{14}$  has been dehydrated by means of aqueous sulfuric or glacial acetic acids to yield the unrearranged olefin, 1,1,2-triphenylethylene-1- $C^{14}$ . When this olefin was heated under reflux with dry xylene containing an equal weight of phosphoric anhydride, a complete isotopic position isomerization occurred, yielding a 50:50 mixture of IIIa and 1,1,2-triphenylethylene-2- $C^{14}$ . This observation can probably best be rationalized in terms of Cram's symmetrical phenonium ion. The semipinacolic dehydrobromination of 2-bromo-1,1,2-triphenylethanol-1- $C^{14}$  to phenyl benzhydryl ketone- $C^{14}$  has been shown to take place with exclusive phenyl migration. (auth)

## URANIUM AND URANIUM COMPOUNDS

510

**A NEW FORM OF THE HYDRIDE OF URANIUM.** Roger Caillat, Henri Coriou, and Pierre Péro. *Compt. rend.* **237**, 812-13(1953) Oct. 12. (In French)

A new form of  $UH_3$  can be obtained by the electrolysis of a  $HClO_4$  or a  $Na_2CO_3$  solution if U is used as the cathode. The reaction of massive U with pure  $H_2$  at  $-40^\circ C$  will also lead to the new form. The hydride is cubic with parameter  $a = 4.153 \pm 0.002$  kx. There are two atoms of U per unit cell, and the density is 11.1. (J.S.R.)

## ENGINEERING

511

**Atomic Energy Research Establishment, Harwell, Berks (England)**  
**THE MODEL TESTING OF ELECTROMAGNETIC FLOW-METERS.** W. Murgatroyd. Oct. 1952. 12p. (AERE-X/R-1053)

The voltage output of most electromagnetic flowmeters does not rigorously obey the simple equation generally used. A qualitative discussion indicates the sources of deviation. It is suggested that flowmeters should be designed

from model tests, and the necessary testing criteria are derived. A tentative design is given for a standard flowmeter. It is recommended that some such standard be adopted, and that tests be carried out on this flowmeter, over as wide a range of variables as possible. Mention is made of a novel type of flowmeter, in which the only measurement made is the force on the magnet. The pros and cons of this are briefly discussed. (auth)

## HEAT TRANSFER AND FLUID FLOW

512

California Univ., Los Angeles

**STUDIES ON DENSITY TRANSIENTS IN VOLUME-HEATED BOILING SYSTEMS. [FINAL REPORT].** July 1953. 135p. Contract AT(11-1)-177. (AECU-2529; Report 53-17)

The results of experiments designed to investigate the transient density response of volume-heated liquid systems subjected to a sudden, short-duration increase in heating intensity are presented. Also included are the results of experiments designed to give information about the characteristics of liquid-solid systems with regard to their maximum superheats. Analytical studies pertaining to limits of the rate of density change, to liquid structure, critical bubble size, and growth rates of bubbles are included. A description of all experimental equipment is given, as are descriptions of systems investigated. Density transients are presented for water systems having a 0.05% concentration (approximately) of KOH. Most tests were performed at atmospheric pressure; some were performed at about 125 to 260 psia. Time lag, the time from the initiation of a heating pulse to the start of a density transient, ranged significantly from about 80 to 700 msec for the systems and variables investigated. The superheat studies revealed that maximum liquid superheat was attained for a glass-water system at atmospheric pressure; the boiling temperature was  $240^\circ F$  above the normal boiling point. Data on superheat up to pressures of about 800 psia are presented for all systems studied. The glass-water system characteristically permitted higher superheats, for all pressures, than were obtained with other systems investigated. For systems employing solutions of  $UO_2(SO_4)$ , superheats attainable were found to be influenced by the length of time the solution was subjected to superheat. (auth)

513

Engineering Research Inst., Univ. of Mich.

**THE HEAT TRANSPORT BETWEEN TWO PARALLEL PLATES AS FUNCTIONS OF THE KNUDSEN NUMBER.** C. S. Wang Chang and G. E. Uhlenbeck. Sept. 1953. 36p. Contract N6onr-23222. (NP-4952)

The treatment of the transport phenomena by starting immediately from the Boltzmann equation has been applied to the problem of heat conduction between 2 parallel plates. Formal expressions for the heat flux and the temperature distribution between the plates can be derived for arbitrary values of  $d/\lambda$ , where  $d$  is the distance between plates and  $\lambda$  is the mean free path. The limiting cases for the Knudsen gas ( $d/\lambda \gg 1$ ) and for the Clausius gas ( $d/\lambda \ll 1$ ) can be deduced from the general expressions. All observable quantities such as the heat flux and the temperature distribution are functions of the Knudsen number  $K = d/\lambda$ . Only for small values of  $K$  can a power-series development in  $K$  be obtained. It is not possible to find a series expansion in inverse powers of  $K$ , since  $K = \infty$  is an essential singularity. The approach to the Clausius regime is therefore more complicated than previously assumed, because of the development of successive types of boundary layers, as is explained in a section in the report on Maxwell molecules. This insight is the main result of this report. (auth)



514

ON THE VELOCITY OF TRANSFER BY THE He II FILM. B. N. Esel'son and B. G. Lazarev. Translated from *Doklady Akad. Nauk S.S.S.R.* 81, 537-7(1951). 6p. (AEC-tr-1246)

The velocity of transfer by the He film was determined by observations of the change of level of He in a glass ampule. However, in contrast to previous experiments, the ampule was placed in a glass vessel with Cu ends surrounded by a Cu screen with observation slits through which the levels could be observed. This vessel was then filled with liquid He. The experiments were carried out with 3 different cylindrical glass ampules 2.54 mm in diam. The rate of change of level in the ampule was studied for outflow and inflow. (J.A.G.)

515

A METHOD FOR THE IMPROVEMENT OF HEAT TRANSFER. Arno Andreas. Translated by Margaret Schloo from [German] *Patentschrift No. 717766*. Feb. 21, 1942. 2p. (AEC-tr-1683)

It is shown that heat transfer in liquid- or gas-conducting tubes around which flows a cool or hot substance can be improved by vibrating the heat-exchanging body by a common device such as a vibrating screen. The frequency of the screen is of the order of at least 1500 vibrations/min with amplitudes of vibration from 1 to 5 mm. Since the substance to be heated or cooled undergoes a continuous or rotating motion at the same time, heat transfer takes place more readily. Also, the heat transfer is increased considerably by heat-exchanging bodies, such as hollow rings, chains, etc., which are firmly or loosely attached in or on the heat exchanger, which are good conductors, and which take part in the slightest motion. (J.A.G.)

516

CONCERNING THE FLOW ABOUT RING-SHAPED COWLINGS. PART 12. TWO NEW CLASSES OF CIRCULAR COWLS. Dietrich Küchemann and Johanna Weber. Translated by Mary L. Mahler from *Zentrale für wissenschaftliches Berichtswesen der Luftfahrtforschung, Berlin. Untersuchungen und Mitteilungen No. 3111*. 72p. (NACA-TM-1360; UM-3111)

For application in practice for annular radiator fairings and similar arrangements, two new classes of circular cowls are developed by theoretical method and investigated in a systematic test series regarding their behavior under various working conditions. (auth)

517

HEAT TRANSFER AT HIGH-POWER DENSITIES. John S. Hickey, Jr. *J. Appl. Phys.* 24, 1312-17(1953) Oct.

The power densities that liquid metal cooling is capable of are explored. The advantages of liquid metals over conventional water cooling are shown. The presentation is such that one can choose between the available coolants for any particular application with a minimum of background. The work done at the General Research Laboratory in developing a vacuum tube anode capable of handling 5 kw/cm<sup>2</sup> is covered. (auth)

## MATERIALS TESTING

518

Illinois Univ. Coll. of Engineering  
[STATUS REPORT TO DETERMINE THE EFFECT OF DIFFERENT STATES OF STRESS ON THE FATIGUE OF MATERIALS WITH CORRECTION FOR ANISOTROPY AND THE BASIC LAWS GOVERNING FAILURE UNDER COMBINED STRESS.] W. N. Findley. Sept. 15, 1953. 22p. Contract DA-11-022-ORD-995. (NP-4940)

The effects of different states of stress on the fatigue strength of SAE 4340 steel and two Al alloys were studied.

Fatigue tests made under bending and torsion provide data by which the anisotropy of the material may be determined. The effect of metallurgical structure on the ratio of fatigue strength in bending to that in torsion was obtained for the steel. The data did not agree with previous data. The effect of the mean stress in axial load fatigue tests was studied. In these tests the material was precompressed before being machined. (J.S.R.)

519

INFLUENCE OF PRIMARY CREEP ON STRESSES IN STRUCTURAL PARTS. Folke K. G. Odqvist. *Acta Polytech. Mech. Eng.* 2, No. 9. 16p. (1953).

Primary creep may be taken into account within a purely phenomenological theory, extended to general three-dimensional stress systems. Two possible theories are investigated separately. In Theory I the creep rate is composed of two terms, one of which is the well known power function of the stress, corresponding to stationary creep, and the other one, corresponding to primary creep, is proportional to the rate of stress multiplied by another power function of the stress. In Theory II the stationary creep rate is taken according to the older theory or according to v. Mises' theory of perfectly plastic solids, depending upon whether the stress is below or at a flow limit of v. Mises' type. Application of Theory II to the case of a rotating disk, by way of numerical calculations with a differential analyzer, is given. (auth)

## MINERALOGY, METALLURGY, AND CERAMICS

520

Massachusetts Inst. of Tech.  
THE ADAPTATION OF NEW RESEARCH TECHNIQUES TO MINERAL ENGINEERING PROBLEMS: PROGRESS REPORT. July 31, 1953. 40p. Contract AT(30-1)-956. (NYO-3678; MITS-20)

The possibility is discussed that the slow adsorption on barite from aqueous solutions of laurate ions may be brought about by a change in the surface of the BaSO<sub>4</sub> during adsorption or by slow precipitation of Ba laurate onto the surface of BaSO<sub>4</sub>. The solubilities of decylamine, dodecylamine, and tetradecylamine in water were determined by a technique involving potentiometric titration with the hydrogen electrode. A graph shows effect of pH on adsorption of Na on quartz. The flotation behavior of positively and negatively charged AgI with Na laurate, Na oleate, Na lauryl sulfate, K ethyl xanthate, decylammonium acetate, and Na diethyldithiophosphate was tested. The preparation of a concentrated Ag<sub>2</sub>S sol is described, and curves show the adsorption of Ag and sulfide ions on chemically precipitated Ag<sub>2</sub>S as a function of the charge on the surface. Results of zeta potential measurements of quartz in solutions of Al(NO<sub>3</sub>)<sub>3</sub> are given. Data on the electrophoretic mobility of sphalerite in systems containing Zn, Cu, and cyanide ions are reported. In a study of the mechanism of adsorption of Cu on sphalerite, attempts were made to determine the adsorption of cyanide ions and Cu-cyanide complex ions on sphalerite. The adsorption density of xanthate on pyrite as a function of neutral electrolyte concentration is shown. Work in progress on sulfate-perchlorate and chloride-perchlorate exchanges in Amberlite IRA-400, the absorption of moisture by the perchlorate form of the resin, and the distribution of ferric



cations between an anion-exchange resin phase and a solution phase is discussed briefly. Strain energy absorption was measured for a pyrex glass rod subjected to longitudinal impact. (A.G.W.)

## CERAMICS AND REFRACTORIES

521

North Carolina State Coll.  
RESEARCH ON VIBRATORY COMPACTING OF METAL AND CERAMIC POWDERS. SECOND QUARTERLY REPORT, JULY 20, 1952–OCTOBER 20, 1952. William C. Bell. [1952] 22p. Contract AF33(616)-73. (AD-369)

The use of low-frequency vibration in the compaction of essentially pure alumina powders was studied. Two types of power sources in this range were used, electrical-mechanical and pneumatic. The powders—of different particle size distributions—were packed in metal dies. Vibrations having a wide range of amplitudes and frequencies were applied to the top and bottom punches in different combinations. The properties of test specimens formed by vibratory packing are compared with similar compositions formed by conventional dry press and slip cast forming methods. Finely ground powders (such as -325-mesh material) were packed, but most of the work was done with combinations of fine and coarse powders. The coarse fraction of the mixtures ranged from -14+28- to -100-mesh material. The fine fraction consisted of particles ranging in size from -325-mesh to -900-mesh material. The average sample contained from 40 to 60% of the fine fraction. All specimens were sintered at a temperature of 3200°F in a gas-fired furnace. The results obtained by vibratory packing methods show promise. Apparent specific gravities of approximately 3.3 compared with the theoretical specific gravity of 3.9 to 4.0 have been obtained with the vibrated specimens which were sintered at 3200°F. The total linear shrinkage for these specimens averaged approximately 0.5%. The absorption of these specimens averaged slightly below 4.0%. In general, similar compositions formed by conventional dry press methods showed lower specific gravities as well as higher shrinkages and absorptions. (auth)

522

NEW VARIETIES OF SINGLE CRYSTALS OF BARIUM TITANATE. I. N. Belyaev, N. S. Novosil'tsev, A. L. Khodakov, and E. G. Fesenko. Translated by J. R. Fisher from *Doklady Akad. Nauk S.S.S.R.* 78, 875-7(1951). 6p. (AEC-tr-1167)

An abstract of this report appears in *Nuclear Science Abstracts* as NSA 6-207.

## CORROSION

523

Livermore Research Lab., California Research and Development Co.  
STATIC CORROSION OF ALUMINUM ALLOYS AT 350°F AND 480°F IN DISTILLED WATER. P. O. Strom and M. H. Boyer. Issued Oct. 1953. 10p. Contract AT(11-1)-74. (LRL-64)

Static corrosion rates were measured for several commercial Al alloys exposed to distilled H<sub>2</sub>O at temperatures of 350 and 480°F. High initial corrosion rates were observed which dropped off rapidly to nearly constant penetration rates of less than 0.3 mil/yr at 350°F and about 1 to 3 mils/yr at 480°F. Alclad 24S, clad with pure Al, was the most resistant of the alloys tested. (auth)

524

Research Foundation, Ohio State Univ.  
COATING FOR THE PROTECTION OF CERAMIC BODIES. FINAL SUMMARY REPORT. F. H. McRitchie. June 15,

1950. 95p. Subcontract SC-2007, Report No. 35. (NEPA-1509)

525

Northrop Aircraft, Inc.  
RESEARCH INVESTIGATION OF PROTECTIVE COATINGS FOR MAGNESIUM. H. D. Childers, K. B. Niles, and A. G. Valles. Nov. 1952. 44p. Contract AF33(038)-23273. (WADC-TR-52-99; AD-2168)

Numerous proprietary and developmental organic coatings are screened for relative corrosion protection of Mg-sheet alloy, with respect to a current government specification system. Superior primers and systems are more fully evaluated for mechanical properties as well as corrosion protection. It was found that air-dry vinyl systems offer optimum protection, considering the systems tested. Developmental data and discussions of Mg corrosion inhibitors and galvanic cell test methods are included in the report. (auth)

526

Northrop Aircraft, Inc.  
IMPROVEMENT OF JET ENGINE DESCALING PROCEDURE. G. M. Bryan. Aug. 1952. 55p. Contract AF33(033)-23310. (WADC-TR-52-100; AD-4090)

X-ray-diffraction analysis of the inconel scale on combustion tube inner liners revealed that it is composed of Ni oxide, the major component, and lesser amounts of Cr oxide and Fe oxide. Metallographic examination demonstrated that heavy scale is associated with precipitation, possibly carbides at the grain boundaries, a fact which can explain intergranular corrosion of scaled inconel in acid solutions. Inconel scale could not be taken off in neutral or alkaline solvents, but several acid solutions were found which remove most of the scale without seriously attacking the base metal. Oxidizing pretreatments, particularly with the alkaline permanganate solution in current use by the Air Force, were shown to promote efficient acid pickling. Physical tests of inconel specimens descaled with the HNO<sub>3</sub>-FeCl<sub>3</sub> solution revealed that high-temperature pickling (160°F) caused a severe loss in tensile strength, whereas room temperature pickling caused no appreciable loss in tensile strength. A full scale test of the HNO<sub>3</sub>-FeCl<sub>3</sub> solution was performed, and satisfactory results were achieved. (auth)

## GEOLOGY AND MINERALOGY

527

Pennsylvania State Coll. School of Mineral Industries  
DIELECTRIC CONSTANTS OF ROCKS AND MINERALS. ANNUAL PROGRESS REPORT FOR 1952-3. B. F. Howell, Jr. Issued Mar. 20, 1953. 41p. Contract AT(30-1)-1345. (NYO-3746)

Apparatus for measuring the dielectric constant of rocks and minerals in the frequency range 50 cps to 30 Mc was assembled. Eight series of measurements on dry samples were made. A detailed schedule of further measurements including plans for testing different methods of measuring the dielectric properties of rocks in place is outlined. Costs, past and future, are estimated, and the probable value of the work is discussed. (auth)

528

Geological Survey  
GEOLOGY OF THE DRY VALLEY QUADRANGLE, IDAHO. E. R. Cressman. Aug. 1952. 12p., 2 illus. (TEI-258)

The Dry Valley quadrangle is one of seven 7½-minute quadrangles in southeastern Idaho being mapped by the U. S. Geological Survey as part of an investigation of the western phosphate field. The formations exposed in the area include the Brazer limestone of Mississippian age, the Wells formation of Pennsylvanian age, the Phosphoria



formation of Permian age, and the Dinwoody and Thaynes formations of Triassic age. All deposits of Cenozoic age other than Quarternary alluvium have been mapped as a single unit. The area is characterized by generally moderate folding striking north-northwest and by a few large faults of similar trend and many short faults of small displacement commonly transverse to the major structures. No mineral deposits other than phosphate rock are known to occur in the quadrangle. The phosphate deposits are found in the phosphatic shale member of the Phosphoria formation, which contains two zones of phosphate rock suitable for mining and processing. (auth)

579

Geological Survey

THE CRYSTAL STRUCTURE OF MONTROSEITE, A VANADIUM MEMBER OF THE DIASPORE GROUP.

Howard T. Evans, Jr. and Stanley Block. Oct. 1953. 19p. (TEI-368)

An x-ray study of single crystals of montroseite,  $(V,Fe)O(OH)$ , shows that it has a structure analogous to that of diaspoire,  $AlO(OH)$ . Cell constants are as follows: orthorhombic, space group  $Pbnm$  ( $D_{2h}^{16}$ );  $a = 4.54$  Å,  $b = 9.97$ ,  $c = 3.03$ ; cell contents, four formula units. Atomic positions are given with interatomic distances obtained as a result of a complete structure analysis by Fourier methods. Details of structure are compared with those of other members of the series. A diffuse auxiliary x-ray lattice produced by montroseite crystals is interpreted as arising from an oxidized phase of composition  $VO_2$ , and having a similar structure, analogous to ramsdellite,  $MnO_2$ . A process of low-temperature oxidation during which the main structural framework is not disturbed is postulated, as in the case of the alteration of lepidocrocite and magnetite to maghemite, and goethite to hematite. (auth)

530

Geological Survey

PRELIMINARY DESCRIPTION OF COFFINITE—A NEW URANIUM MINERAL. T. W. Stern and L. R. Stieff.

Oct. 1953. 4p. (TEM-647)

Coffinite, identified from 11 mines on the Colorado Plateau, is black with an adamantine luster and is closely associated with carbonaceous material, black V minerals, quartz, and clay. Coffinite is best identified by its x-ray powder pattern, which is similar to that of thorite but contains no Th. Analyses of the mineral indicate as much as 61% U with varying amounts of Si, As, and V. There is not sufficient  $SiO_2$  present for the mineral to be a simple U silicate. It is associated with low-valence V minerals, uraninite, and pyrite and is believed to be a major U mineral in the nonoxidized black ores of the Colorado Plateau. (J.E.D.)

METALS AND METALLURGY

531

Metals Research Lab., Carnegie Inst. of Tech.

RATES OF MARTENSITE-TYPE REACTIONS USING FAST AMPLIFIER TECHNIQUES. SUMMARY REPORT FOR PERIOD JULY 1, 1952 TO DECEMBER 31, 1952.

R. F. Bunshah, E. E. Lahteenkorva, and R. F. Mehl. Dec. 31, 1952. 19p. Contract AF 18(600)-161. (AD-1932)

532

Battelle Memorial Inst.

ALLOYS FOR HIGH-TEMPERATURE SERVICE. FINAL REPORT. R. L. Beck, E. E. Fletcher, A. R. Elsea, A. B. Westerman, and G. K. Manning. Apr. 30, 1952. 27p. Contract N5ori-111, T. O. 1. (AD-11576)

A metallographic and x-ray-diffraction study was made to determine the Co-Cr binary diagram. The effects of ternary additions of N, Fe, Ni, Mo, or W, all components of

vitalium-type alloys, on the reactions which occur in the Co-rich terminal solid solutions of this binary system were established. Metallographic and x-ray-diffraction studies were conducted to determine the phase relationships in Stellite No. 21 (vitalium) after various heat treatments. Creep-rupture tests were made on Co-Cr alloys with and without N. Aging, creep-rupture, and hot-hardness of Stellite No. 21-type alloys were studied. (J.A.G.)

533

National Bureau of Standards

THE SILVER-URANIUM SYSTEM. FINAL REPORT.

R. W. Buzzard, D. P. Finkle, and J. J. Park. [1953] Decl. Oct. 7, 1953. 14p. (AEC-3600)

A survey of the Ag-U system has been made, and a constitution diagram was developed by correlation of thermal, x-ray, and microscopic studies. A monotectic occurred in the system at approximately 0.23 wt. % of Ag and 1132°C with a liquid miscibility gap extending from 0.23 wt. % to approximately 94.5 wt. % of Ag. A eutectic-like structure in both U-rich and Ag-rich alloys was observed at approximately 5 wt. % of U and 95°C. The solubility of U in Ag appeared to be between 0.1 and 0.4 wt. %, while no appreciable solubility of Ag in U was noted. The  $\gamma$ - $\beta$  and  $\beta$ - $\alpha$  transformations of U were apparently unaffected by Ag. (auth)

534

General Electric Research Lab.

DISCUSSION OF "THE SYSTEM ZIRCONIUM-ALUMINUM BY D. J. McPHERSON AND M. HANSEN." J. H. Keeler. [nd] 2p. Contract W-31-109-eng-52. (AECU-2744)

In a discussion of a paper on the system Al-Zr it is shown that a pearlitic breakdown of  $Zr_3Al$  in an alloy containing 13.5 wt. % or 34.5 at. % Al takes place. There is evidence of a lamellar structure, believed to be precipitated  $Zr_3Al$ , in alloys containing approximately 10 at. % Al. It was observed that  $Zr_3Al$  is ductile at and above 800 to 850°C. (J.E.D.)

535

Institute of Engineering Research, Univ. of Calif., Berkeley  
PRINCIPLES OF SOLUTION HARDENING. TECHNICAL REPORT NO. 12. Earl R. Parker and Thomas H. Hazlett. Oct. 1953. 73p. Contract AT-11-1-Gen-10. (AECU-2745)

Mechanisms of solution hardening for both single and polycrystalline materials are reviewed. The general effects of alloying indicate that solid solutions are invariably stronger than the pure parent metals, the yield strength increases with increasing amounts of an alloy element at large strains, the slope of the stress-strain curve is usually increased when solute atoms are added to a metal, and in dilute ternary alloys each element seems to contribute the same increment of strength that it did in the binary alloy. (J.E.D.)

534

Ames Lab.

THE NIOBIUM-VANADIUM ALLOY SYSTEM. H. A. Wilhelm, O. N. Carlson, and J. M. Dickinson. Oct. 20, 1953. 17p. Contract W-7405-eng-82. (ISC-401)

On the basis of microscopic studies, melting point observations, and x-ray analyses, a phase diagram is proposed for the Nb-V system. A complete series of solid solutions are formed with a minimum in the solidus at 1805° near 35 wt. % Nb. No compounds or intermediate phases were found in the system above 650°C. (auth)

537

Metallurgical Advisory Board, National Research Council  
BORON STEELS. FIRST REPORT OF PANEL ON SUBSTITUTION OF ALLOYING ELEMENTS IN ENGINEERING STEELS. July 16, 1951. 39p. Contract DA-49-025-sc-83. (MAB-4-M; Report 1)

A summary of steel-making practices, applications, and



properties of the B steels which can be used as a reference for furthering the application of these steels and thereby conserving critical alloys of Ni, Cr, Mo, and Mn is presented. This information was obtained through a comprehensive survey of the literature and from unpublished reports and communications from the producers and users of B steels. Principal items of discussion are the conservation of alloys by induction hardening and by use of B, B agents and methods of addition, hardenability, limitations of B-treated steels, and other properties of B steels. (J.A.G.)

538

Pitman-Dunn Labs., Frankford Arsenal  
A STUDY OF THE CONFLICTING RELATIONSHIP BETWEEN HARDNESS CONVERSION TABLES PUBLISHED IN FEDERAL SPECIFICATION QQ-M-151a AND ASTM DESIGNATION E48-47. M. A. Dougherty. Apr. 1952. 17p. (MR-500; ATI-167073)

Hardness tests were conducted on 17 carbon and alloy steel specimens using Rockwell, Brinell, and diamond pyramid hardness-testing equipment. Conversion relationship curves were plotted between Rockwell and Brinell and diamond pyramid hardness numbers and compared with curves published by the federal government. (J.S.R.)

539

National Bureau of Standards  
EFFECTS OF CERAMIC COATINGS ON THE CREEP RATE OF METALLIC SINGLE CRYSTALS. PROGRESS REPORT NO. 2 [FOR] SEPTEMBER 15, 1952 TO DECEMBER 15, 1952. Dec. 15, 1952. 12p. Contract AF33(616) 52-19. (NBS-2106; AD-1830)

540

Chalk River Project (Canada)  
THE NEPTUNIUM-ALUMINUM INTERMETALLIC COMPOUNDS. O. J. C. Runnalls. [1953] 14p. (NP-4768)

The intermetallic compounds  $\text{NpAl}_2$ ,  $\text{NpAl}_3$ , and  $\text{NpAl}_4$  were prepared and examined by x-ray-diffraction methods. The compounds are isostructural with the corresponding U-Al compounds.  $\text{NpAl}_2$  is face-centered cubic with  $a = 7.785 \text{ \AA}$  and has the  $\text{MgCu}_2$  structure.  $\text{NpAl}_3$  is simple cubic with  $a = 4.262 \text{ \AA}$  and has the  $\text{AuCu}_3$  structure.  $\text{NpAl}_4$  is body-centered orthorhombic with  $a = 4.42 \text{ \AA}$ ,  $b = 6.26 \text{ \AA}$ , and  $c = 13.71 \text{ \AA}$ . The published description for the atomic positions in  $\text{UAl}_4$  applies also to  $\text{NpAl}_4$ . (auth)

541

Columbia Univ. School of Mines  
A FUNDAMENTAL STUDY IN THE PRINCIPLES COVERING SEIZING AND GALLING IN METALS. QUARTERLY PROGRESS REPORT FOR FEBRUARY 6, 1953 TO MAY 6, 1953. E. S. Machlin and W. R. Yankee. 9p. Contract AF-18-600-75. (NP-4868; Quarterly Progress Report 5)

Static friction coefficients of several surfaces in contact are tabulated. The effect of cleaning surfaces in  $\text{N}_2$  on static friction coefficients is reported. Static friction coefficients on a Ti surface previously heated in air at  $350^\circ\text{C}$  for 17 hr are shown. The data are analyzed. (L.T.W.)

542

Columbia Univ. School of Mines  
A FUNDAMENTAL STUDY IN THE PRINCIPLES COVERING SEIZING AND GALLING. FINAL SUMMARY REPORT FOR YEAR ENDING FEBRUARY 5, 1953. E. S. Machlin, W. R. Yankee, and R. Duncan. 36p. Contract AF-18-600-75. (NP-4869)

Results obtained in a fundamental study of seizure and galling are reported. Two conclusions are as follows: 1. Titanium surfaces seize equally well or better to metal oxides as compared to clean metals for the case where the free energy of formation of the metal oxides, at room temperature, is less than for  $\text{TiO}$  per mole of  $\text{O}_2$ . The only case tested where the free energy of oxide formation

exceeds that of  $\text{TiO}$  (the metal Mg) showed an increased seizability of Ti to clean Mg than to the oxide layer on Mg produced in air. 2. Lack of mutual solid solubility of metal pairs does not imply lack of solid-phase weldability, in general. Mutually insoluble pairs have been found to seize at room temperature as well or better than mutually soluble pairs. (auth)

543

Battelle Memorial Inst.  
SURFACE HARDENING OF TITANIUM BY CARBURIZING AND INDUCTION HEAT TREATMENT. FIRST INTERIM TECHNICAL REPORT COVERING THE PERIOD SEPTEMBER 1, 1952 TO MARCH 31, 1953. A. J. Griest, P. E. Moorhead, P. D. Frost, and J. H. Jackson. Apr. 30, 1953. 36p. Contract DA-33-019-ORD-942. (NP-4929; Interim Technical Report No. 1)

Progress is reported on the development of methods for surface hardening Ti alloys by treatment with  $\text{C}_3\text{H}_8$ -A mixtures in order to improve their wear resistance and to lessen their tendency to gall and seize. Investigations were made at various temperatures and  $\text{C}_3\text{H}_8$  concentrations. Tests showed that the most wear-resistant cases are those produced by a treatment at a temperature of about  $1800^\circ\text{F}$  for 8 hr in an A-0.5%  $\text{C}_3\text{H}_8$  mixture. Composition of the alloy and the mechanical features of the carburizing process, i.e., gas circulation, etc., also influenced the depth of case. Wear-test data indicated that the cases produced with the use of  $\text{CH}_4$ -A and  $\text{C}_2\text{H}_6$ -A mixtures as carburizing atmospheres are inferior to those developed with  $\text{C}_3\text{H}_8$ -A mixtures. Some work was done on developing tests for the adherence and brittleness of the carburized surfaces. Gas carburizing with CO-A mixtures was studied. Several experiments were carried out in an effort to deposit  $\text{TiC}$  on a hot Ti surface by reaction of  $\text{TiCl}_4$  or  $\text{TiI}_4$  with  $\text{CH}_4$ . (J.A.G.)

544

Massachusetts Inst. of Tech.  
PERIODIC STATUS REPORT NO. 5, AUGUST 1953 [TO] NOVEMBER 1953. PART 1. DEFORMATION STUDIES OF METALS AT ELEVATED TEMPERATURES. PART 2. THE IRON-CHROMIUM-NICKEL TERNARY SYSTEM. PART 3. EFFECT OF STRUCTURE AND COMPOSITION ON THE STRENGTH PROPERTIES OF STAINLESS STEEL. H. C. Chang, F. C. Monkman, Peter Price, and N. J. Grant. 7p. Contract N5-ori-07881. (NP-4942)

Work preparatory to studies of deformation in Cr-Ni alloys at elevated temperatures is reported. Stress-rupture data are presented for samples of steel having a wide composition range. Results are presented of preliminary tests of the effect of structure and composition on the strength properties of stainless steel. (C.H.)

545

Institute of Engineering Research, Univ. of Calif., Berkeley  
DISCUSSION OF PAPER "CREEP BEHAVIOR OF EXTRUDED ELECTROLYTIC MAGNESIUM" BY C. S. ROBERTS IN JOURNAL OF METALS, AIME, SEPTEMBER 1953, pp. 1121-1126. TECHNICAL REPORT NO. 31. O. D. Sherby and R. E. Frenkel. Oct. 15, 1953. 12p. Contract N7-onr-295, T.O. 2. (NP-4947)

A discussion of a recent paper entitled "Creep Behavior of Extruded Electrolytic Magnesium" is presented. It is shown that the elevated-temperature creep data can be correlated by means of the expressions derived in earlier technical reports, namely,  $\epsilon = f(t e^{-\Delta H/RT}, \sigma)$  and  $\sigma = F(\dot{\epsilon} e^{-\Delta H/RT})$ , where  $\epsilon$  = creep strain,  $t$  = time under stress  $\sigma$ ,  $\dot{\epsilon}$  = secondary creep rate,  $\Delta H$  = activation energy for creep,  $R$  = gas constant, and  $T$  = absolute temperature. The activation energy for creep of Mg was found equal to about 31,000 cal per mole independent of stress, temper-



ature, and the various creep structures developed during creep. It is believed that this value is also the activation energy for self-diffusion of Mg. (auth)

545

Towne Scientific School, Univ. of Penna.  
DEFORMATION OF BERYLLIUM SINGLE CRYSTALS AT 25°C TO 500°C. FINAL REPORT. H. T. Lee and R. M. Brick. Sept. 23, 1953. 103p. Contract ONR-24908. (NP-4949)

Compression tests at room temperature, 300, and 500°C have been conducted on single crystals of Be for various orientations. Slip and twinning elements were determined from surface markings by microscopic examinations and by x-ray analyses. The operative slip planes at temperatures of 250, 300, and 500°C were established as (0001) and  $\{10\bar{1}0\}$ ; the single twinning plane as  $\{10\bar{1}2\}$ . Cleavage planes were found to be either (0001) or  $\{11\bar{2}0\}$ . Deformation and kink bands were also observed. A peculiar type of macroscopic band was found present in several specimens with a particular orientation, and an explanation accounting for its formation is given. Measurement of the displacement of cracks across slip bands has led to an evaluation of the local strains resulting from basal slip as a comparison to the average shear. A selection rule based on an extension of LeChatelier's principle is advanced for the choosing of active twinning planes from the total ones available. Crystallographic analyses regarding twinning and slip are given. A mathematical relationship is given to describe the atomic movements in twinning of close-packed hexagonal metals. Factors of periodicity and crystallographic shear are also considered for their relation with the selection of slip and twinning elements. (auth)

547

Engineering Research Inst., Univ. of Mich.  
THE PHASE TRANSFORMATIONS AND HEAT-TREATABILITY OF TITANIUM-BASE ALLOYS. FINAL REPORT COVERING PERIOD MAY 24, 1951 TO JUNE 1, 1953. C. W. Phillips and J. C. Tobin. June 1953. 137p. Contract DA-20-018-ORD-11456. (NP-4950)

Test results on the effect of various heat treatments on the hardness, tensile and impact properties, and microstructures of three alloys, RC-130A (7% Mn nominal), RC-130B (4% Mn, 4% Al, nominal), and Ti-150A (2.7% Cr, 1.3% Fe nominal) are reported. Heat treatments consisted of brine quenching and air cooling from various temperatures, various cooling rates from the all- $\beta$  temperature range, brine quenching and aging, oil quenching and aging, isothermal transformation from the all- $\beta$  condition, end-quench tests and time-temperature- $\beta$ -grain-size determinations. (auth)

548

Massachusetts Inst. of Tech.  
THE DUCTILE FRACTURE OF METALS. MECHANICAL ANISOTROPY IN SAE 4340 STEEL. TECHNICAL REPORT NO. 4. Davis S. Fields, Jr., Walter A. Backofen, and John Wulff. Sept. 30, 1953. 29p. Contract N5ori-07841. (NP-4951)

The tensile fracture characteristics after various amounts of torsional prestrain have been studied in specimens of SAE 4340 steel of three grades: vacuum-melted, aircraft quality, and commercial quality. The presence of a submicroscopic crack structure is indicated in all three grades by the transition from high to low values of tensile fracture stress and strain-to-fracture, after critical amounts of prestrain in torsion. The vacuum-melted steel, which is practically inclusion-free, is affected somewhat more by twisting; in particular, the critical prestrain value is lower. The commercial and aircraft grades, however, are practically identical in their response

to prestraining. It appears, therefore, that inclusions are not the principal source of microcracks in the materials tested, and that static transverse properties are not greatly influenced by inclusion content, within the range encountered in this work. Since there is a marked difference in grain size between the commercial and aircraft quality steels, it is also concluded that prior austenitic grain size is not a primary factor in the behavior studied. Certain systematic scatter in the data is explained on the basis of oriented microcracks. (auth)

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Notre Dame Univ.  
ORDER-DISORDER TRANSFORMATIONS IN METALLIC ALLOYS. FINAL REPORT [FOR] OCTOBER 17, 1952 [TO] OCTOBER 17, 1953. G. C. Kuczynski. 34p. Contract DA-11-022-ORD-1116. (NP-4959)

Au-Cu alloys corresponding to almost the exact composition AuCu were disordered at 415, 440, and 650°C for 20 hr. The samples were water-quenched and ordered isothermally at various temperatures below 400°C. Electrical resistivity measurements and x-ray and metallographic examination revealed that the ordering process was the faster the higher the disordering temperature. The samples disordered at lower temperatures (415, 440°C) exhibited long induction periods when ordered at temperatures close to 400°C. It was found that there are two temperature zones defined by two sharply different mechanisms of transformation. Zone A extends from 360 to 405°C. The ordering in this zone is a function of nucleation only, and its rate increases with decreasing temperature. The resulting structure contains plates of an ordered phase readily observable under a microscope. These plates form and propagate in an extremely short time (a fraction of a second). Zone B contains all temperatures below 375°C. The rate of ordering in this zone decreases with decreasing ordering temperatures. An analysis of the electrical resistivity vs. time curves reveals that this phase also is nucleated, but its growth is slow. (auth)

550

Carnegie Inst. of Tech.  
PROGRESS REPORT FOR APRIL, MAY, JUNE 1953. R. Smoluchowski, C. Coleman, L. Couling, S. Hayes, C. W. Haynes, and Y. Y. Li. Sept. 1, 1953. 4p. Contract AT-30-1-GEN-359. (NYO-3486)

Study of grain-boundary diffusion in the Al-Cu system is continued. Investigation of self-diffusion along grain boundaries in body-centered lattices and the study of anisotropy of diffusion in grain boundaries are reported. High resolution small-angle scattering camera has been improved. (For preceding period see NYO-3485.) (auth)

551

Carnegie Inst. of Tech.  
SMALL ANGLE X-RAY SCATTERING STUDY OF IMPERFECTIONS IN COPPER. S. Hayes and R. Smoluchowski. Oct. 25, 1953. 7p. Contract AT-30-1-GEN-359. (NYO-3487)

Upon annealing, the small-angle x-ray scattering in deformed Cu first increases and then decreases in the angle range between 10 and 30'. This result combined with Blin and Guinier's observation that under similar conditions the scattering decreases in the range of 1.5 to 7° may be interpreted as an indication of clustering of defects prior to their disappearance. (auth)

552

Columbia Univ. [School of Mines]  
THE STUDY OF DIFFUSIONLESS PHASE CHANGES IN SOLID METALS AND ALLOYS: [PROGRESS REPORT FOR MARCH 1 TO MAY 31, 1953]. T. A. Read, D. S. Lieberman,



M. S. Wechsler, and C. W. Chen. 3p. Contract AT(30-1)-904. (NYO-3962; CU-14-53-AEC-904-Met.)

Habit-plane indices, orientation relationship, and shear were calculated for the austenite-martensite transformation in Fe-base alloys, yielding results in good agreement with experimental observations. Metallographic studies of the diffusionless transformation of the Au-Cd alloys containing 49 to 50 at. % Cd were made on an electrolytically polished surface of a cubic single crystal of the higher-temperature phase. Upon completion of transformation on cooling, one or more sets of parallel-sided bands were observed in the low-temperature phase. The bands of each set were twin-related. By means of polarized light, sharp contrasts were observed in the intensity of reflected light between adjacent bands within each set as well as between adjacent sets of bands. (For preceding period see NYO-3961.) (J.A.G.)

553

Pittsburgh Univ.  
MAGNESIUM-CADMIUM ALLOYS. PART 5. LOW TEMPERATURE HEAT CAPACITIES AND A TEST OF THE THIRD LAW OF THERMODYNAMICS FOR THE MgCd SUPERLATTICE. C. B. Satterthwaite, R. S. Craig, and W. E. Wallace. [July 1, 1953]. 21p. Contract AT(30-1)-647. (NYO-6160)

The heat capacities of an alloy containing 50.52 at. % Cd between 11 and 304°K are presented. From these data the entropy increase between 0°K and 25°C is computed, and an estimate of the residual entropy for the superlattice (intermetallic compound) MgCd is made. The alloy deviates negatively from the Kopp-Neumann rule below 200°K, where the configuration is frozen-in. At temperatures of 230°K and above a transformation is observed. This has been established as the beginning of the order-disorder transition, which culminates in destruction of the superlattice at 528°K. In the temperature range where the configuration is changing positive deviations from the Kopp-Neumann rule are observed. Debye characteristic temperatures are presented for the alloy, the equivalent mixture, and the pure component metals. (auth)

554

Pittsburgh Univ.  
MAGNESIUM-CADMIUM ALLOYS. PART 6. HEAT CAPACITIES BETWEEN 12 AND 320°K AND THE ENTROPIES AT 25° OF MAGNESIUM AND CADMIUM. R. S. Craig, C. A. Krier, L. W. Coffer, E. A. Bates, and W. E. Wallace. [July 1, 1953]. 11p. Contract AT(30-1)-647. (NYO-6161)

Constant-pressure heat capacities of Mg and Cd are reported for temperatures between 12 and 320°K. From these data the entropies at 25° are found to be  $7.78 \pm 0.01$  and  $12.37 \pm 0.01$  eu/g-atom for Mg and Cd, respectively. Constant-volume heat capacities and Debye characteristic temperatures are also reported. The behavior of the calorimeter indicated a minimum in the thermal conductivity of Cd at about 225°K. (auth)

555

Massachusetts Inst. of Tech.  
SOLID SOLUTION FORMATION IN THE GOLD-NICKEL SYSTEM. B. L. Averbach, P. A. Flinn, and Morris Cohen. Aug. 1, 1953. 29p. Contract AT(30-1)-1002, Scope 2. (NYO-7034)

The local atomic configurations measured from diffuse x-ray scattering in the Au-Ni system cannot be reconciled with the observed heats and entropies of mixing on the basis of a statistical treatment of chemical bonding energies. The heats of mixing are positive (heat absorbed), and yet there is a preference for unlike neighbors in solutions above the solubility gap. It is shown that these positive heats of

mixing may be explained in terms of the elastic strain energy required to form solutions from atoms of different size. The sizes of the atoms in Au-Ni solutions, also measured from the diffuse x-ray measurements, are used to calculate the strain energies, and reasonable agreement with the observed heats of mixing is obtained. The strain energy contribution to the heat of mixing in  $\text{Cu}_2\text{Au}$  is also evaluated approximately from x-ray determination of the atomic size effect. In this system it appears that a significant negative contribution to the heat of mixing may arise from a change in the electronic configuration on alloy formation. (auth)

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Sylvania Electric Products, Inc., Atomic Energy Div.  
DIFFUSION IN BIMETAL VAPOR-SOLID COUPLES. R. W. Balluffi and L. L. Seigle. [Sept. 2, 1953] 37p. Contract AT-30-1-GEN-367. (SEP-125)

The intrinsic diffusivities of individual components in several binary systems have been determined with vapor-solid-type diffusion couples. In this type of couple a high vapor pressure component is diffused from the vapor phase into a slab of lower vapor pressure initially containing inert markers on its surface. Diffusivities may then be calculated from marker movement and diffusion-penetration curve data. Equations necessary for analysis of such couples are developed. The  $\alpha$  brass, Cu-Ni, and Ag-Au systems were investigated. Observations of polygonization during diffusion and dimensional changes normal to the diffusion direction were also made. Porosity formation, which occurred only in the vapor-solid Ag-Au couples, was investigated in detail and was compared to porosity formation in corresponding sandwich couples. The general use and limitations of such couples in diffusion studies are discussed. (auth)

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Battelle Memorial Inst.  
DEVELOPMENT OF SUBSTITUTES FOR STAINLESS STEEL IN SPECIFIC APPLICATIONS. QUARTERLY REPORT COVERING THE PERIOD OF OCTOBER 1, 1951 TO DECEMBER 31, 1951. H. A. Robinson, H. O. McIntire, and G. K. Manning. Jan. 10, 1952. 26p. Contract DA-36-039-sc-15323. (U-20823; Quarterly Report 2)

Melts of 3 classes of austenitic Fe-base alloys were prepared: (1) C-Mn-Fe materials containing 0.03 to 1.2% C, 13 to 16% Mn, 0.3% Si, and 0 to 0.1% B; (2) Cr-Mn-Fe alloys containing 0.04 to 0.3% C, 5 to 18% Cr, 6 to 10% Mn, 0.3% Si, 0 to 0.2% N, and 0 to 0.3% B; and (3) a Cr-Ni-Fe alloy containing 0.12% C, 18% Cr, 9% Ni, 1.1% Mn, and 0.5% Si. As-cast alloys having zero or low Magne-Gage values were forged and rolled at 1900 to 2200°F. Alloys which forged successfully also hot-rolled. Generally, non-magnetic as-cast alloys remained nonmagnetic after forging and rolling. Magne-Gage values were independent of the quench-annealing temperature between 1600 and 2200°F. A magnetic martensitic surface layer formed, apparently caused by loss of C or of C and Mn during forging. Alloys retaining magnetic properties after forging and rolling were lime-coated and cold-drawn through successively smaller dies until tip breakage occurred. The best austenitic Ni-free alloy drew about 70% before breaking. A modified 18-8 type alloy with 6% Ni drew 77%. A ferritic alloy containing 10% Cr and 8% Mn withstood 99% reduction in area before breaking; attempts to carburize 0.058-in.-diam. sections of the alloy to demagnetize it were promising. Magne-Gage values of the carburized wire ranged from 7 to 45 compared with 148 for the as-cast ingot. In the C-Mn-Fe alloys, the work-hardening rate decreased and drawability improved with decreasing C content. A 10% Cr content appeared optimum in the Cr-Mn-Fe materials. B



was not a promising element in alloys containing C or N. (See also TIP U20129.) (auth)

558

Tour, Sam, and Co., Inc.  
NITRIDING AND CARBONITRIDING OF TITANIUM METAL AND ITS ALLOYS. FINAL TECHNICAL REPORT. Joseph Gitto and Andre Styka. Aug. 3, 1953. 60p. Contract DA-30-069-ORD-863. (WAL-401/49/23)

The nitriding of Ti and Ti alloys in dissociating  $\text{NH}_3$  and N has been completed. Hard adherent surfaces have been obtained. Evaluation of physical properties of resultant nitrided Ti and Ti alloy specimens such as hardness, adherence, structure, impact, and tensile strength are included. A complete résumé of the process is included. The carbonitriding of Ti and Ti alloys was investigated. Mixtures of propane, air, and  $\text{NH}_3$  were utilized in all experiments. The effect of temperature, time, and gas mixture on hardness and case characteristics were studied. Tensile and impact specimens were treated and tested. (auth)

559

Fansteel Metallurgical Corp.  
STUDY AND RESEARCH OF THE SILICONIZING OF TITANIUM. FINAL TECHNICAL REPORT FOR PERIOD JULY 1, 1952 THROUGH MAY 31, 1953. Stanley Kluz, Ralph Wehrmann, and Caesar Kalinowski. 29p. Contract DA-11-022-ORD-1069. (WAL-401/51-22)

Four methods of applying Si coatings were investigated; paint and sinter, vapor phase deposition, flame spray, and cementation. The study of the paint and sinter method, which gave the most promising coatings, was the major activity of the program. Although coatings were obtained by sintering in  $\text{H}_2$  or He, the best results were obtained by sintering in vacuum. The vapor phase method gave coatings that, in general, were discontinuous and not well bonded. Efforts to obtain coatings by packing Ti strips in Si powder and heating (cementation) were not successful. A very brief investigation of the flame spray method of coating gave very promising results. In one instance, a coating (ten mils thick) was obtained. The coatings were tested for resistance to oxidation by a combination visual examination, weight change, and thermal shock method. In addition, some of the physical properties of the coated base metal were determined. Pellets, bars, and crucibles of  $\text{Ti}_3\text{Si}_3$  were prepared by the powder metallurgy method, and some of their physical properties determined. (auth)

560

Armour Research Foundation  
SURFACE HARDENING OF TITANIUM WITH METALLOID ELEMENTS. FINAL TECHNICAL REPORT, JUNE 1, 1952 [TO] MAY 31, 1953. R. W. Hanzel, V. Pulsifer, and S. W. McGee. 152p. Contract DA-11-022-ORD-289. (WAL-401/84-25)

The various surface-hardening processes have been examined to determine their applicability to Ti and its alloys. The experimental study included the known hardening effect of  $\text{N}_2$ ,  $\text{O}_2$  addition by heating in air, carburizing, and the addition of  $\text{H}_2$ . The treatments in purified  $\text{N}_2$  included a number of special Ti-base binary alloys and several commercial alloys. The Ti-base V and B alloys developed the most promising final surface hardness. This report contains data describing the notched-bar impact properties and wear resistance of nitrided unalloyed Ti. A complete résumé of the treatment of unalloyed Ti in molten borax is included, along with information on dissociated  $\text{NH}_3$  and fused-salt bath treatments. (auth)

561

New York Univ. Coll. of Engineering  
TITANIUM PHASE DIAGRAM STUDY. INTERIM

TECHNICAL REPORT NO. 2. June 15, 1953. 49p.  
Contract DA-30-069-ORD-208. (WAL-401/85-24; Interim Technical Report No. 2)

The ternary phase diagrams were constructed of the Ti-Mn-Fe, Ti-Mn-O, Ti-Mo-Al, Ti-Fe-Mo, and Ti-Mo-O systems. Alloys were prepared in the range to approximately 30 wt. % of the metallic alloying element and approximately 7 wt. % O. The variation of hardness with composition in as-cast and ductile hot-rolled alloys is included. Experiments to establish a procedure for the preparation of Ti-Pb binary alloys are described. (auth)

562

Columbia Univ.  
RESEARCH ON THE EFFECT OF PLASTIC DEFORMATION ON TRANSFORMATION IN TITANIUM ALLOYS. FINAL TECHNICAL REPORT. Aug. 1953. 43p. Contract DA-30-069-ORD-547. (WAL-401/148-14; CU-14-53-ORD-547-Met.)

The effects of stress and plastic deformation on the habit, crystallography, and other characteristics of the  $\beta$ - $\alpha'$  transformation in the Mo-Ti binary alloys are reported. (J.A.G.)

563

Watertown Arsenal Lab.  
HEAT TREATMENT AND ALLOYING OF TITANIUM. L. D. Jaffe. June 23, 1953. 44p. (WAL-401/191)

The heat treatment of Ti alloys may be based upon a single curve showing how hardness and brittleness vary with time. By starting with  $\beta$  and holding at temperatures below the  $\beta$  transus, an alloy will harden to 450 to 550 Vickers, becoming quite brittle, as  $\beta$  transforms to  $\beta'(\beta + X)$ . After longer times, the hardness will drop and toughness rise as  $\beta'$  breaks up into  $\beta + \alpha$ . The prime effect of alloying elements is to retard these changes. 51 references. (auth)

564

TIN-BISMUTH-ANTIMONY SYSTEM. THERMAL AND MICROSCOPIC INVESTIGATION OF THE TERNARY SYSTEMS. Rudolph Vogel. Translated by I. A. Warheit from *Z. Metallkunde* 44, 323-4(1953). 4p. (AEC-tr-1735)

A survey is given of the structure of the system Sn-Sb-Bi. Only the crystals which exist in the boundary system appear as participants in the reactions. (auth)

565

ON LOCAL DISTORTIONS OF THE CRYSTAL LATTICES OF ALLOYS DURING TRANSFORMATION HARDENING. L. Moroz and T. Mingin. Translated from *Doklady Akad. Nauk S.S.S.R.* 91, 249-51(1953). 3p. (NSF-tr-99)

The integrated intensities of the (220) and (110) lines in the same x-ray photograph for quenched and highly tempered samples of alloyed Fe were compared. They were also compared to the intensities of the lines in x-ray photographs of plastically deformed samples. An Fe alloy with 0.02% C, 4.3% Mn, and 0.97% Cr was used. The data suggested that a considerably smaller number of atoms with incoherent attachment due to static distortions of the lattice was formed during quenching than during plastic deformation. It was also assumed that there was a substantial difference in the nature of the local lattice distortions of an alloy which is in the states of transformed and mechanically cold-worked metal. (J.A.G.)

566

ON THE NATURE OF VISCOUS DESTRUCTION OF METALS. V. A. Pavlov. Translated from *Doklady Akad. Nauk S.S.S.R.* 91, 253-5(1953). 3p. (NSF-tr-100)

A study of the change in the properties of metal under plastic deformation by determining the relation between the impact toughness and the magnitude of the preliminary plastic tensile deformation is reported. (J.A.G.)



567

AN X-RAY INVESTIGATION OF AGE HARDENING IN AlAg. C. B. Walker and A. Guinier. *Acta Met.* **1**, 568-77(1953) Sept. (In English)

An AlAg alloy containing 20% Ag by weight has been investigated with both low-angle and high-angle x-ray-scattering techniques. The diffuse scattering from samples quenched from the region of solid solubility has shown that during the quench the majority of the Ag atoms of the alloy have clustered together into small spherical aggregates, each of which is surrounded by regions low in Ag content. With annealing the clusters first grow in size, the atoms continuing to remain on the matrix lattice sites. After sufficient annealing the hexagonal  $\gamma'$  precipitate, of composition  $\text{Ag}_2\text{Al}$  abruptly appears in the form of platelets, thin in the (000.1) direction, which exhibit faults in the stacking of the (000.1) planes. On further annealing the platelets grow and become more perfect. The interpretation of the mechanism of precipitation offered by Guinier thus appears to be justified for this alloy. (auth)

568

A STUDY OF DEFORMED AND RECOVERED ALUMINUM CRYSTALS BY A NEW X-RAY TECHNIQUE. C. A. Julien and B. D. Cullity. *Acta Met.* **1**, 588-97(1953) Sept. (In English)

By the use of a Soller slit in the primary beam and a line source of x rays, the focusing Laue method of Guinier and Tennevin has been extended to allow the detection and measurement of torsional strain in a crystal lattice. Focused reflections from planes other than those considered by Guinier and Tennevin may also be obtained under these conditions. In deformed single crystals of Al, torsionally strained regions of the lattice are found to occur quite generally. Deformation is found to be highly inhomogeneous when an extended region of a deformed crystal is examined. The reversibility of plastic deformation is shown. Polygonization of bent specimens is confirmed, and it is shown that crystals deformed by torsion may recover by partial untwisting rather than by polygonization. (auth)

569

THE EFFECTS OF NEUTRON IRRADIATION IN THE NRX REACTOR ON THE ORDER-DISORDER ALLOY  $\text{Cu}_3\text{Au}$ . L. G. Cook and R. L. Cushing. *Acta Met.* **1**, 539-48(1953) Sept. (In English)

The irradiation of  $\text{Cu}_3\text{Au}$  with neutrons causes two separable effects. Disordering is caused by fast neutrons, and is negligible with thermal neutrons; the effect is independent of temperature at least up to 100°C. Volume disordering rates of 28.9%/day have been observed with fission spectrum neutrons. A secondary effect, probably ordering, is caused by thermal neutrons; the effect is dependent on temperature even below 100°C. The simultaneous formation of substantial amounts of Hg is probably the direct cause of the effect. NRX "reactor spectrum" neutron irradiation produces both effects, which mutually interfere. If the thermal component of the neutron spectrum is screened out, it seems likely that the disordering effect on  $\text{Cu}_3\text{Au}$  can be used as a measure of neutron damage potential to other materials. (auth)

570

THE EFFECTS OF NEUTRON IRRADIATION IN THE NRX REACTOR ON THE ORDER-DISORDER ALLOY  $\text{CuAu}$ . L. G. Cook and R. L. Cushing. *Acta Met.* **1**, 549-51(1953) Sept. (In English)

The irradiation of  $\text{CuAu}$  with neutrons causes two separable effects. Disordering is caused by fast neutrons, and is negligible with thermal neutrons; the rate is approximately 0.7 times the rate for  $\text{Cu}_3\text{Au}$ . A secondary effect, probably ordering, is caused by thermal neutrons, very likely through

the agency of the Hg formed, as with  $\text{Cu}_3\text{Au}$ . The effect is much more pronounced with  $\text{CuAu}$  than with  $\text{Cu}_3\text{Au}$ , probably owing to the fact that the initial "freezing in" temperature is about 80°C instead of 200°C. (auth)

571

THE SPLITTING OF DISLOCATIONS IN METALS WITH CLOSE-PACKED LATTICES. A. Seeger and G. Schöck. *Acta Met.* **1**, 519-30(1953) Sept. (In German)

The present paper deals with two problems in the theory of dislocations: (1) the elastic properties of straight dislocation lines in crystals of arbitrary symmetry, and (2) the splitting of half-dislocations in closest-packed lattice planes. It turns out that the usual splitting into pure edge dislocations and pure screw dislocations is only possible if the direction of the dislocation line is an even symmetry axis. Another simplification with respect to the most general case occurs when the dislocation line is situated in a reflection plane (but not rotation-reflection plane). The splitting of the half dislocations is treated for both edge and screw dislocations by means of the variation method first used by Leibfried and Dietze, using the concept of a specific stacking fault energy and taking the anisotropy fully into account. Numerical results are given for Cu, Al, and Co. Some of the results deviate considerably from those based on the stacking fault energy and isotropic elasticity. (auth)

572

INTERNAL FRICTION OF IRON AND MOLYBDENUM AT LOW TEMPERATURES. Lo-Ching Chang and M. Gensamer. *Acta Met.* **1**, 483-6(1953) Sept. (In English)

An internal friction peak has been found in Fe at about 100°K, and possibly in Mo at about 300°K. These internal friction peaks occur at temperatures corresponding to the ductile-to-brittle transition of these materials in slow tension tests. The possible role of  $\text{H}_2$  in causing the 100°K peak in Fe is briefly discussed. (auth)

573

ADDITIONAL NOTES ON TEXTURES IN EXTRUDED ALUMINIUM. K. V. Gow. *Acta Met.* **1**, 610(1953) Sept. (In English) (cf. NSA 7-4601)

It has been noted that the mean rotation of 46° about the (111) axes for the "Y" grains in extruded Al corresponds to the 47° (13°) rotation obtained upon annealing a compressed single crystal of Al. Rotations of 22, 28, and 13° about the (111) axes provide the first, second, and third greatest density of coincidence lattice sites. Thus, the greater scatter in angular rotation for "X" grain may be attributed to the growth of nuclei which have selected lattice sites corresponding to these rotations. (J.S.R.)

574

CUTTING TOOL FOR ALKALI METALS. D. B. Trauger. *Rev. Sci. Instr.* **24**, 989(1953) Oct.

Clean cutting of soft metals is quickly achieved by drawing No. 20 piano wire through the metal in a device in which tension is supplied by winding the wire on a hand-turned spindle. (K.S.)

## PHYSICS

575

Brookhaven National Lab.  
PARAMAGNETIC RESONANCE ABSORPTION OF CARBAZYL AND HYDRAZYL. C. Kikuchi, Brookhaven National Lab. and Michigan State Coll. and V. W. Cohen, Brookhaven National Lab. [1953] 34p. (BNL-1606)

The paramagnetic resonance spectra of single crystals



of carbazyl and hydrazyl show distinct anisotropies which appear to be associated with the microscopic magnetic susceptibility within the molecule in the vicinity of the unpaired electron. This leads to an asymmetry in the absorption line of a polycrystalline specimen. The hyperfine structures of the two radicals in a benzene solution show that in carbazyl the two N atoms are non-equivalent in that the added electron remains approximately twice as long in the vicinity of one compared to the other. (auth)

576

Ames Lab.

QUARTERLY SUMMARY RESEARCH REPORT IN PHYSICS FOR APRIL, MAY AND JUNE 1953. Oct. 1, 1953. 16p. Contract W-7405-eng-82. (ISC-395)

Light and heavy fission fragment energy distributions are tabulated in A, N, and Ne atmospheres. A spraying technique has been developed for making thin U films. New  $\beta$ -ray spectral data are reported for  $C^{14}$ ,  $S^{35}$ , and  $Ni^{63}$ . Preliminary studies on the mirror nuclei  $Na^{21}$ ,  $Si^{27}$ ,  $K^{37}$ ,  $Mg^{23}$ , and  $S^{31}$  have yielded new half-life values for these isotopes. Magnetic susceptibility measurements on Nd metal by the Gouy method were made over a temperature range of 20 to 300°K. The behavior of the magnetic moment of Dy at 4.2°K has been investigated. (For preceding period see ISC-338.) (K.S.)

577

Solid-State and Molecular Theory Group, Mass. Inst. of Tech.

DETERMINATION OF THE DIELECTRIC CONSTANT AND CONDUCTIVITY OF GERMANIUM BY MICROWAVE METHODS. TECHNICAL REPORT NO. 2. Hsi-Teh Hsieh. 28p. Contract N5ori-07856. (NP-4938)

The theoretical aspects of the determination of the dielectric constant and conductivity of Ge by microwave methods are discussed. The Q of a cavity containing various shapes of samples is derived. (J.S.R.)

578

Centro Brasileiro De Pesquisas Fisicas, Rio de Janeiro (Brazil)

ATOMIC THEORY OF LIQUID HELIUM. NOTAS DE FISICA NO. 12. R. P. Feynman. July 21, 1953. 5p. (NP-4939; Notas de Fisica No. 12)

Liquid He II is studied from first principles, and it is shown how the central features of the two-fluid model arise. After taking any atomic configuration A and assuming the amplitude of the wave function to be positive, a new configuration B is found in which the negative amplitude is the only difference from A. It is deduced that the wave function of the excited states of such a configuration will be of the form  $\psi = \sum_i f(\vec{R}_i) \phi$  where  $\phi$  is the ground state function,  $f(R)$  is +1 if R is at A and -1 if at B, and the sum is taken over all the atoms of coordinates  $\vec{R}_i$ . The energies of  $f(\vec{R})$  are calculated. It is concluded that the states available at low temperatures are either phonons or excitations near the minimum of the liquid form factor for He at absolute zero. (J.S.R.)

579

General Electric Research Lab.

THE HEAT CAPACITIES OF THE ELEMENTS BELOW ROOM TEMPERATURE. Carl A. Shiffman, comp. Oct. 1952. 70p. (NP-4945)

A handbook of heat capacities of elements below room temperature, including data tables and a comprehensive bibliography, is presented. The quantities tabulated are specific heats at constant pressure at temperatures of 1° through 298.2°K; values of  $\gamma$ , the linear coefficient in the accepted specific-heat form, computed from direct calorimetric measurements; and values of  $\gamma$  computed

from magnetic-threshold curves in the case of the superconducting elements. 266 references. (J.A.G.)

580

Research Lab. of Electronics, Mass. Inst. of Tech.

AN INDUCTION METHOD OF MEASURING ELECTRICAL RESISTIVITY. TECHNICAL REPORT NO. 125. H. E. Rorschach, Jr. and Melvin A. Herlin. Oct. 12, 1952. 28p. Contract DA36-039-sc-100. (NP-4960)

A method for measuring the electrical resistivity of a cylindrical specimen of metal is described. The specimen is mounted at the center of a pair of concentric coils whose complex mutual inductance is measured. The field equations for this geometry are solved so that mutual inductance values may be used to yield resistivity values. The method is particularly useful for low-temperature measurements because no electrical or other connection needs to be made to the specimen and because the sample size and shape are suitable both for ease of preparation and for other measurements. (auth)

581

Yale Univ.

DIFFUSION COEFFICIENTS FOR THE SYSTEM DIPHENYL IN BENZENE. C. Lennart Sandquist and Philip A. Lyons. Oct. 15, 1953. 23p. Contract AT(30-1)-1375. (NYO-3879)

The diffusion coefficients, densities, viscosities, and specific refractive increments for solutions of diphenyl in benzene have been determined at 25 and 35° in the concentration region 0 to 3M. Attention has been called to the significance of the overlapping of the plots of  $D\eta/T$  against  $c$  at the two temperatures. A simple and useful deviation function has been proposed for the description of this type system. The activation energies for the viscous and diffusion processes have been compared. The suggestion has been made that the data, in particular at 25°, constitute reliable standards for calibration purposes. (auth)

582

Pittsburgh Univ.

ACOUSTIC WAVE VELOCITIES, ELASTIC CONSTANTS AND DEBYE CHARACTERISTIC TEMPERATURE FOR POLYCRYSTALLINE MgCd. Charles S. Smith, Case Inst. of Tech.; W. E. Wallace, University of Pittsburgh. [July 1, 1953]. 3p. Contract AT-(30-1)-647. (NYO-6159)

The longitudinal and transverse wave velocities in a polycrystalline Mg-Cd alloy containing 50.6 at. % Cd were measured by the pulsed ultrasonic method. The observed transit times for the longitudinal and transverse waves were  $3.60 \pm 0.02$  and  $7.00 \pm 0.02$   $\mu$ sec respectively, from which  $0.02 \pm 0.05$   $\mu$ sec was subtracted to allow for end effects. From the corrected transit times a compressibility of  $\beta_T = 2.18 \times 10^{-6}$  atm $^{-1}$  is obtained. The Debye characteristic temperature computed from the sound velocities is 220°K. (J.S.R.)

583

DIELECTRIC LOSSES IN CERAMIC DIELECTRICS AND BARIUM TITANATE AT HIGH FREQUENCIES. A. L. Khodakov. Translated from Zhur. Tekh. Fiz. 20, 529-32 (1950). 5p. (AEC-tr-1420; ACSIL/ADM/51/605)

584

EFFECT OF ADMIXTURES OF ANTIMONY AND TELLURIUM ON THE ELECTRICAL PROPERTIES OF SELENIUM. I. L. Kozlovskii and D. N. Nasledov. Translated from Zhur. Tekh. Fiz. 13, 627-36(1943). 17p. (AEC-tr-1421)

585

ADIABATIC COMPRESSIBILITY OF LIQUIDS IN THE CRITICAL REGION. V. F. Nozdrev. Translated by E. Rabkin from Doklady Akad. Nauk S.S.S.R. 84, 317-19(1952). 7p. (AEC-tr-1427; TT-332)



586  
DISCONTINUITIES OF CONDUCTIVITY IN BARIUM TITANATE. N. A. Tolstoi. Translated from *Zhur. Tekh. Fiz.* 20, 970-4(1950). 8p. (AEC-tr-1435; AERE-Trans-11/3/5/181)

587  
A METALLIC COMPOUND OF LITHIUM AND AMMONIA. ELECTRICAL CONDUCTIVITY AND GALVANOMAGNETIC EFFECT. Hans Jaffle. Translated by Margaret L. Schloo from *Z. Physik* 93, 741-61(1939). 20p. (AEC-tr-1740)

It is found that a saturated solution of Li in liquid  $\text{NH}_3$  (about 4 moles  $\text{NH}_3$  to 1 mole Li) hardens at  $-180^\circ$  into a solid compound, which, like the solution, shows a metallic reflection of a Cu-like color. The specific resistance of the saturated solution is about half as great as that of Hg at room temperature and almost independent of temperature; the specific resistance of the solid at  $-190^\circ$  is  $\frac{1}{4}$  as great and shows a positive temperature coefficient of about 2%. The saturated solution of Li in  $\text{NH}_3$  is the lightest liquid in existence at room temperature, having a density of 0.48. The solid compound shows a normal negative Hall effect; the Hall constant at  $-190^\circ$  was found to be  $R = -1.38 \cdot 10^{-3} \text{ cm}^3/\text{amp sec}$ . From this it follows that exactly one free electron is present per atom of Li. At about  $-200^\circ$  a transformation of the substance is observed, and the Hall constant suddenly increases to the fourfold value. At the same time the resistance becomes strongly dependent on the magnetic field. Only an upper limit for the Hall effect for the liquid can be proven with certainty. The experimental results are explained on the basis of a uniform representation of the solid compound and the saturated solution. (auth)

588  
ENERGY LEVEL STRUCTURE OF THE ANTIMONY-CESIUM CATHODE. N. S. Khlebnikov and A. E. Melamid. Translated from *Doklady Akad. Nauk S.S.S.R.* 63, 649-51 (1948). 7p. (AEC-tr-1478)

589  
HEAT CAPACITY OF WATER-PHENOL SOLUTIONS IN THE CRITICAL REGION. Kh. I. Amirhanov and I. G. Gurvich. Translated from *Doklady Akad. Nauk S.S.S.R.* 91, 221-3(1953). 3p. (NSF-tr-97)

The heat capacity of a phenol(34 wt. %)-water solution was measured in a calorimeter with intense mixing. An analysis of the data showed no change in the heat capacity in the critical region within the limits of experimental accuracy. Measurements of the temperature field in the solution by means of differential thermocouples were made which showed a sharp increase in temperature gradients observed in the critical region. Thermal analysis showed that the cooling rate ceases to decrease in the critical region even with slight agitation. (J.A.G.)

#### COSMIC RADIATION

590  
RELATIVE IONIZATION BY COSMIC RAY  $\mu$  MESONS IN A LIQUID SCINTILLATOR. R. Baskin and J. R. Winckler. *Phys. Rev.* 92, 464-7(1953) Oct. 15.

Measurements of the rise in energy loss of  $\mu$  mesons of energy between 385 and 2200 Mev in traversing a xylene solution have been made. The observed pulse-height distribution is compared with the most probable energy loss and median energy loss as found by use of the Landau theory without a density correction and with a density correction as calculated by Sternheimer. The result of this measurement favors a density correction to the theory of energy loss. (auth)

591  
MULTIPLE CORES IN AIR SHOWERS. Osman El-Mofty. *Phys. Rev.* 92, 461-3(1953) Oct. 15.

Multiple cores in cosmic-ray air showers are difficult to observe because of the overlapping of the cores. After transition to equilibrium with  $\text{H}_2\text{O}$  the cores are much smaller and readily identified. Decoherence measurements of the coincidences between pulses in ionization chambers have been made for depths in  $\text{H}_2\text{O}$  from 0 to 3 m and with separation of the chambers up to 6 m. The decoherence measurements are consistent with an average air shower at 9000 ft which has about 20 cores within a distance of about 5 m from the shower's center. (auth)

592  
ATMOSPHERIC EFFECTS ON COSMIC-RAY INTENSITY NEAR SEA LEVEL. S. Olbert. *Phys. Rev.* 92, 454-61 (1953) Oct. 15.

The effects of atmospheric temperature and pressure on the  $\mu$ -meson intensity are studied theoretically for locations near sea level. The analysis is based on a unidimensional equation for the vertical differential intensity of  $\mu$  mesons, studied originally by Sands. The treatment is rigorous in the sense that it includes the continuous production as well as the ionization losses of  $\mu$  mesons in the atmosphere. With the help of a newly derived range spectrum of  $\mu$  mesons at production and the exact expression for the survival probability of  $\mu$  mesons, a three-term regression formula for the relative changes of the  $\mu$ -meson intensity is derived and discussed in detail. According to this formula, the relative intensity changes are correlated not only with the average production height and the ground pressure (a customarily employed two-term correlation) but also with the average tropospheric temperature. This additional correlation, resulting from the ionization losses of  $\mu$  mesons in the air, seems to remove some apparent difficulties in the interpretation of experimental data. In particular, it seems to explain the discrepancies found in the decay coefficients determined from diurnal and seasonal observations, respectively. (auth)

593  
DISTRIBUTION OF ARRIVAL TIMES OF AIR SHOWER PARTICLES. P. Bassi, G. Clark, and B. Rossi. *Phys. Rev.* 92, 441-51(1953) Oct. 15.

The instantaneous distribution of particles in extensive air showers at sea level was studied by measuring the relative delays between particles with three liquid scintillation counters. The delays measured were in the range from 5 to 300  $\mu\text{sec}$ . The sizes of the showers were in the range from  $10^6$  to  $10^8$  particles. By means of statistical methods of analysis it was found that at a given instant most electrons with energies of  $\sim 20$  Mev lie in a flat disk of thickness between 1 and 2 m. The particles which can penetrate at least 20 cm of Pb lie in a disk of thickness between 2 and 3 m. The disk of penetrating particles follows behind the disk of electrons by less than 3 m. The projected zenith angles of the axes of individual showers were determined by measuring the delays between widely spaced counters. The standard deviation of a measurement of the sine of the projected zenith angle of a shower was 0.13. The rms of the sines of the projected zenith angles was found to be  $0.24 \pm 0.015$ . If a  $\cos^n \theta$  distribution law is assumed for the projected zenith angles,  $n = 15 \pm 1.2$ . The spatial orientations of the axes of individual showers were determined by measuring the projections of the zenith angles on two mutually perpendicular planes. (auth)

594  
PROPERTIES OF HEAVY UNSTABLE PARTICLES. D. Lal, Yash Pal, and B. Peters. *Phys. Rev.* 92, 438-40(1953) Oct. 15.



A block of emulsion consisting of unbacked emulsion sheets can be used as a very efficient detector for heavy unstable particles and provide favorable conditions for mass and energy determinations. The mass of the  $\tau$  meson was obtained as  $M_\tau = 3m_\pi + Q$ , where  $Q = 76.0 \pm 0.9$  Mev. Fairly accurate mass values are obtained for the positive K meson, and four examples of the capture of negative heavy mesons are presented, two of them leading to emission of a  $\pi$  meson. A charged particle of mass higher than that of a proton which decays in flight into a meson is discussed. In most of these cases the nuclear event giving rise to the heavy mesons could be observed. The Q value of the  $V_1^0$  particle was determined as  $37 \pm 2$  Mev, and other examples which may represent the decay of neutral particles are discussed. (auth)

595

#### THE TIME VARIATION OF COSMIC-RAY HEAVY NUCLEI.

Victor H. Yngve. *Phys. Rev.* **92**, 428-35(1953) Oct. 15.

Two  $4 \times 4$  Ilford G5 photographic emulsions in contact were exposed to the cosmic radiation in such a way that one plate was moved slowly and uniformly with respect to the other. By this technique it is possible to determine the time at which heavy nuclei pass through the plates. The plates were exposed above 90,000 ft on June 4, 1952, for 8 hr during the day. A reliable altitude record was available and was used to correct for the altitude changes during the 8 hr. 947 heavy nuclei with more than 10 delta rays per 100  $\mu$ , corresponding to Z greater than about 10, were traced through and their time of passage measured. This was done by new techniques which are described in detail. The data have been divided into three time intervals. The intensity during the middle interval between noon and 2 p.m. is greater by  $25 \pm 8.5\%$  than the average of the other two. It is concluded that this is due to a real fluctuation in the intensity of cosmic-ray heavy nuclei at the top of the atmosphere. The possibility that this may be due to a dipole magnetic field of the sun is discussed. (auth)

596

#### EFFECTS OF THE GEOMAGNETIC FIELD ON SOLAR COSMIC RAYS. V. Sarabhai and R. P. Kane. *Phys. Rev.* **92**, 415-19(1953) Oct. 15.

The force acting on a charged solar cosmic ray due to the action of the geomagnetic field has been analyzed in terms of its components along the E-W, the N-S, and the vertical directions. With certain simplifying assumptions, the relative magnitudes of these components and their directions have been determined for specific values of the geographic latitude  $\lambda$  of the place of observation, as well as the declination  $\delta$  and the hour angle  $t$  of the sun. The deflection that can be produced in the trajectories of solar cosmic rays is qualitatively discussed in terms of the resulting changes which may be expected in the hour of maximum of the diurnal variation of cosmic rays assumed to be due to particles from the sun. It appears that the hour of maximum should become later with increase of latitude. In a northern latitude, a north-pointing cosmic-ray telescope should reveal a diurnal variation with an earlier maximum than a south-pointing telescope. There is a possibility, therefore, of being able to interpret the experimental results of directional studies of the diurnal variation of cosmic rays in terms of geomagnetic effects. (auth)

597

#### SEARCH FOR HIGHLY ABSORBABLE NEGATIVE COSMIC-RAY PARTICLES AT SEA LEVEL. Charles E. Miller, Joseph E. Henderson, David S. Potter, William R. Davis, Wayne M. Sandstrom, Gerald R. Garrison, and Francis M. Charbonnier. *Phys. Rev.* **92**, 406-11(1953) Oct. 15.

A search has been made at sea level for negative cosmic-ray particles (other than electrons) which are absorbed in

147 g/cm<sup>2</sup> of Pb and which have momenta greater than that of  $\mu$  mesons of this range. The momentum and sign of the charge of those particles stopping in the absorber were determined by means of a counter-controlled cloud chamber operated in a magnetic field. During 1400 hr of operation no negatively charged particle in the momentum interval 0.4 to 1.7 bev/c was recorded as stopping in the absorber. This result has been used to show that the intensity of negative particles with strong nuclear interaction cannot amount to as much as 0.05% of the total intensity of negative particles in this momentum interval. It has been shown that the local production of negative  $\mu$  mesons in the momentum interval 0.5 to 1.0 bev/c is less than  $8.8 \times 10^{-6}$  particle/(cm<sup>2</sup> steradian hr meter). A lower limit of  $6.9 \times 10^5$  g/cm<sup>2</sup> of Pb has been set on the removal path length of  $\mu$  mesons in the momentum interval 0.4 to 1.6 bev/c. (auth)

598

#### ON THE PENETRATING SHOWER ORIGINATING IN LIGHT ELEMENT AND HEAVY ELEMENT. S. Higashi, T. Kitamura, T. Kubozoe, M. Oda, S. Ozaki, and Y. Watase. *J. Phys. Soc. Japan* **8**, 584-90(1953) Sept.-Oct.

Comparison was made of the penetrating shower originating in C and Pb. By use of the counter hodoscope and the Wilson cloud chamber, the multiplicity of the penetrating shower and the absorption of the shower particle and the secondary event produced by the shower particle were observed. Consequently, different energy spectra at lower energy and its equality at higher energy of the shower particles for different size of the mother nucleus were tentatively concluded and discussed. (auth)

#### CRYSTALLOGRAPHY AND CRYSTAL STRUCTURE

599

#### FORM OF LATTICE DISTORTION THAT MAY RENDER A CRYSTAL PLASTIC. M. Polanyi. Translated by Margaret V. Colven from *Z. Physik* **89**, 660-4(1934). 5p. (AEC-tr-1741)

600

#### ON THE COMPLEX STRUCTURE OF THE LAUE SPOTS OF THICK CRYSTALS. Jacques Despujols and Pierre Lucasson. *Compt. rend.* **273**, 1021-3(1953) Oct. 23.

Explanations are sought for the band-structure of Laue spots produced in the x-ray-diffraction patterns of thick (3- and 12-mm) quartz crystals. (K.S.)

#### ELECTRICAL DISCHARGE

601

#### A NOTE ON THE ANALYSIS OF FIRST-ORDER GLOW CURVES. Leonard I. Grossweiner. *J. Appl. Phys.* **24**, 1306-7(1953) Oct.

Simple equations are developed which permit the calculation of the trap depth and frequency factor of first-order glow curves from the temperatures of the peak and the half-height. The equation for the trap depth does not depend explicitly on the frequency factor or the heating rate and is accurate to 5% over a wide range. Application is made to theoretical glow curves and to an experimental glow curve obtained from the thermoluminescence of ice. (auth)

#### ELECTRONS

602

#### NUMERICAL INTEGRATIONS OF THE EQUATION OF ELECTRON TRAJECTORIES. Michel Laudet. *J. phys. radium* **14**, 604-10(1953) Nov. (In French)

By beginning with the method of successive integrations, a rigorous expression for the three-term recursion formula is immediately established for equal successive intervals and generalized to the case of irregular intervals. A comparatively detailed study is made between different recur-



sion formulas of three terms, used in the form of matrix multiplication, that permit verification of the numerical calculations in each case. (tr-auth)

603

**POLARIZATION OF ELECTRONS BY SCATTERING. III. REFLECTION-TRANSMISSION EFFECT.** Norio Ryu, Kimio Hashimoto, and Itaru Nonaka. *J. Phys. Soc. Japan* 8, 575-9(1953) Sept.-Oct.

With electrons obliquely incident on a foil the intensities of the electrons scattered through a certain angle are different on the reflecting and on the transmitting side because of the plural scattering. This phenomenon is called the reflection-transmission effect. This effect has been measured experimentally and compared with the calculation which is only a rough estimation. The experimental results obtained are in good agreement with the calculation at energies higher than 80 kev when thin Au foils are used. Since the plural scattering greatly influences the result of electron polarization experiments, the experimental results obtained previously by one of the authors (N.R.) must be corrected from this point of view. It is interesting to compare these corrected values with the theoretical ones obtained by Bartlett and Welton and recently by Mohr, considering a nuclear screening by the orbital electrons, and by Bartlett and Watson using the pure Coulomb field. The agreement between experimental results and the corrected theoretical ones is not perfect, but it may be considered to be unavoidable that there are some differences between them, if one takes into account the fact that a small change in the nuclear screening makes a considerable effect on the theoretical values. (auth)

604

**THE STRAGGLING OF FAST ELECTRONS.** Seizaburo Kageyama, Kazuaki Nishimura, and Yoshio Onai. *J. Phys. Soc. Japan* 8, 682-3(1953) Sept.-Oct.

The introduction of second-order quantum terms in the Landau theory of electron energy loss in matter provides a theoretical energy distribution curve with a wider spread. The refined theory agrees more closely with the energy curve obtained for 1414-kev conversion electrons passing through an Al foil of 12.0 mg/cm<sup>2</sup>. (K.S.)

## INSTRUMENTS

605

Washington Univ. School of Medicine, Seattle  
**A RECORDING GAS FLOWMETER.** A. C. Young. Dec. 1952. 5p. Published by the Arctic Aeromedical Lab. Ladd Air Force Base, Alaska. Contract AF33(038)422. (AD-1181)

A flowmeter is described which records instantaneous flow and minute volume. The range of the instrument is from 1/4 to 300 l/min for instantaneous flow, and from 1/4 to 100 l/min for average or integrated flow. The special features of the instrument are: (1) ease of cleaning and (2) freedom from large errors when mucous or water is carried into the flowmeter. (auth)

606

Air Force Cambridge Research Center  
**INSTRUMENTATION FOR GEOPHYSICAL RESEARCH. [REPORT] NO. 1. A DIGITAL ELECTRONIC DATA RECORDING SYSTEM FOR PULSE-TIME TELEMETERING.** Gilbert O. Hall—Robert M. Slavin, ed. Feb. 1953. 47p. (AFCRC-TR-53-1)

In the past, the methods used for scaling telemetering records have been time consuming and not too accurate. The DIGER system provides a means of producing at high speed a sample-by-sample record of the telemetered information in digital form and at a slower rate, printing the values of voltages recorded. The system has been

designed to handle two channels of pulse-time telemetering. The delay of a telemeter pulse, which is a measure of the voltage telemetered, is converted into a train of pulses. These pulses are counted by a digital chain, and the coded result is displayed on neon lights which are photographed. This process is repeated at the repetition rate of the system (569 pulses/sec). The photographic record is then scanned by photoelectric means, decoded, and the result printed on electric typewriters. The system is currently in use for recording and reduction of data telemetered from Air Force Aerobee rocket flights for upper air research. The equipment can be expanded to handle more channels or modified to operate with other types of modulation. The method is adaptable to digital range measurements and laboratory recording of large quantities of data. (auth)

607

Brookhaven National Lab.  
**CURIE EVALUATION OF HOLLOW CYLINDER SOURCES.** Otto A. Kuhl, Bernard Manowitz, and Walter Rosenzweig. Sept. 1, 1953. 20p. (BNL-260)

Curie strengths of hollow cylinders of pile-irradiated Co and Ta have been estimated by three different techniques. One is a refined pile activation calculation, the second a calculation involving a derived relationship between the curie content of a hollow cylinder and the radiation field intensity at its center, and the third a point source calculation. Results of calculations for a large number of sources in the kilocurie range indicate an agreement between the three methods within an average deviation of 10%. (auth)

608

Ames Lab.  
**ADAPTATION OF A GEIGER-COUNTER X-RAY DIFFRACTOMETER FOR HIGH TEMPERATURE INVESTIGATIONS.** P. Chiotti. Oct. 5, 1953. 19p. Contract W-7405-eng-82. (ISC-412)

The construction of a specimen holder and furnace for use as an auxiliary piece of equipment with a high-angle goniometer is described. The apparatus can be used for obtaining x-ray-diffraction patterns at temperatures up to 1600°C and at pressures in the range of  $2 \times 10^{-8}$  to  $3 \times 10^{-5}$  mm of Hg. (auth)

609

Laboratory for Insulation Research, Mass. Inst. of Tech.  
**A REGULATED CONTROL SYSTEM FOR A LARGE ELECTROMAGNET. TECHNICAL REPORT NO. 73.** L. E. Johnson. Sept. 1953. 39p. Contracts N5ori-07801, Nr-074-041, and N5ori-07858. (NP-4955)

The design and performance of a regulated control system for a large electromagnet is described. The system is an automatically self-correcting device to maintain the magnet current at any desired level. It is designed as a servomechanism to function as a follow-up device for varying input commands, as well as to compensate for certain extraneously caused current fluctuations. The latter include variations due to temperature changes, generator brush noise, generator structural asymmetries, and changes in generator speed caused by variations in line voltage. These fluctuations are randomly distributed in time, ranging from occasional small shifts and slow drift in the d-c value of the current to noise with appreciable components up to 12 kc/sec. The present control system is designed to compensate for the drift and small shifts in the d-c value of the current at any desired current level but does not compensate for the components of noise of higher frequency. That is, it essentially determines the set point or d-c value of the magnet current. Slow thermal drift and small shifts in the d-c value are held to within one part in 10<sup>5</sup>. Features of the present control system include con-

tinuous variability of the magnet current from maximum negative to maximum positive values with stabilization provided at any desired level of the current, quick reversibility of the polarity for convenience in demagnetization, and complete elimination of switching in the magnet circuit itself. (auth)

610

Geological Survey

THE MODEL VI TRANSMISSION FLUORIMETER FOR THE DETERMINATION OF URANIUM. Charles A. Kinser.

Oct. 1953. 20p. (TEI-370)

An improved transmission fluorimeter (Model VI) for use in the determination of U consists of a line-operated, low-voltage d-c supply, powering a small 3-w ultraviolet lamp as a source of long wavelength ultraviolet radiation; a Model V phototube housing and fluorimeter head containing the sample holder, shutter, and primary and secondary filters; an end-window multiplier phototube powered by a very stable, commercially available high-voltage supply; and an electronic microammeter for measuring the output current from the photomultiplier tube. The instrument has excellent electrical stability and operates over a wide range of sensitivity. Its versatility makes it useful for both routine and research work. (auth)

611

Atomic Energy Project, Univ. of Calif., Los Angeles  
AN EXTERNAL CONDENSER APERTURE CENTERING  
AND INTERCHANGING DEVICE FOR THE RCA EMU  
ELECTRON MICROSCOPE. Francis W. Bishop. Issued  
Oct. 28, 1953. 9p. Contract AT-04-1-GEN-12. (UCLA-  
270)

An external aperture-centering and interchanging device for the EM condenser lens is described. It permits precise alignment of the illuminating system and makes possible the selection of the optimum aperture for various kinds of work, such as the sublimation of the embedding material of thin sections, electron diffraction, etc. Its use greatly increases the flexibility of the electron microscope. (auth)

612

PRACTICAL REALIZATION OF A SQUARE-WAVE PULSE  
GENERATOR FOR GENERAL USE. L. Winand and E.  
Donneaux. *Bull. soc. roy. sci. Liège* 22, 305-9(1953)  
June-July. (In French)

Design of a square-wave generator is described which is capable of delivering 1-, 10-, and 100- $\mu$  sec positive and negative pulses at a variable repetition rate of 1 to 10,000 cps. Pulse amplitudes are continuously controllable from 1 to 75 v. (K.S.)

## ISOTOPES

613

Brookhaven National Lab.

A NEW 3.0-min Ce FISSION PRODUCT AND ITS 5.95-hr  
Pr DAUGHTER. S. S. Markowitz, W. Bernstein, and  
S. Katcoff. [1953]. 12p. (BNL-1583)

Rapid chemical separations of Ce from neutron-irradiated U led to identification of a 3.0-min Ce which decays to 5.95-hr Pr. The former emits  $\beta$  rays, whose maximum energy is approximately 2.0 Mev, and  $\gamma$  rays which were not investigated. The Pr decays by emission of a single  $\beta$  ray whose maximum energy is 1.7 Mev; no  $\gamma$  rays were found. This chain has tentatively been assigned to mass 145. (auth)

614

Oak Ridge National Lab.

THE INVENTORY OF ELECTROMAGNETICALLY EN-  
RICHED ISOTOPES. C. P. Keim, C. E. Normand, and

Boyd Weaver. Oct. 31. 1953. 45p. Contract W-7405-  
eng-26. (ORNL-1640)

This inventory lists the isotopes which have been concentrated electromagnetically, along with their enriched abundances, the element weights, and product forms available in milligram quantities to users on AEC projects and in university and industrial laboratories. Occasional isotope lots are listed which have been exhausted, but their enriched isotopic abundance indicates what may be expected on inventory replenishment. (auth)

## ISOTOPE SEPARATION

615

ENRICHMENT OF ISOTOPIC MOLECULES IN THE DI-  
RECT-CURRENT GLOW DISCHARGE. II. MULTIPLICA-  
TION PROCESSES. CONCENTRATION OF HEAVY HYDRO-  
GEN. H. D. Beckey, W. E. Groth, and K. H. Welge. *Z.  
Naturforsch.* a8, 556-62(1953) Sept. (In German)

The dependence of the enrichment of H-D mixtures in D at the cathode of a d-c glow discharge on length and cross section of the discharge tube, current density, gas pressure, temperature, time, and tube-wall conditions has been investigated systematically. The results are explained on the basis of a theory of multiplication of the primary processes involved in dissociation of the molecules and recombination of the atoms during axial flow in the discharge. Agreement between measurement and theory is obtained. (tr-auth)

616

ISOTOPIC EFFECT IN THE ELECTROLYTIC MIGRATION  
OF THE SILVER ION IN MOLTEN SILVER CHLORIDE. S.  
Floberg, A. Klemm, and C. Lang. *Z. Naturforsch.* a8, 562-  
4(1953) Sept. (In German)

The relative difference between the electrolytic migration velocities of the Ag isotopes with respect to the Cl ions in molten AgCl was found to be 0.0012. The resulting mass effect  $\mu = -0.064 \pm 0.006$  confirms a previously derived expression. (tr-auth)

617

ENRICHING STABLE ISOTOPES ELECTROMAGNETICALLY.  
C. P. Keim. *J. Appl. Phys.* 24, 1255-61(1953) Oct.

The natural stable isotopes of 43 elements, comprising 177 different nuclides, have been enriched; the goal is to enrich 257 isotopes of 59 elements. The isotopic enrichments, the operation of the production mass spectrographs including a listing of best charge materials, a brief review of the chemical and analytical problems, a tabulation of the best compounds of the separated isotopes for mass spectrometer analyses, and a listing of some of the major uses of separated isotopes have been included in this survey of the electromagnetic isotope separation program. (auth)

## MASS SPECTROGRAPHY

618

Brookhaven National Lab.

AN IMPROVED MASS SPECTROMETER ION SOURCE.  
Oliver A. Schaeffer. [1953?] 12p. (BNL-1608)

Modifications of an electron impact ion source for a 60° mass spectrometer are described. The changes consist of (1) an almost completely enclosed ionization region which greatly reduces the contribution of ions from thermal decomposition products on the filament and reduces the contribution of background peaks and (2) a built-in aligned and stronger magnetic field which eliminates source magnet adjustment, collimates the electron beam better and permits the use of a higher repeller voltage thereby increasing the collection efficiency for ions with initial kinetic energy. The performance of the source is described. (auth)



## MATHEMATICS

519

Knolls Atomic Power Lab.

TABLES OF SELF-EQUILIBRATING FUNCTIONS. G. Horvay and J. S. Born. [1953] 22p. Contract W-31-109-Eng-52. (KAPL-1005)

520

RAND Corp.

THE INCOMPLETE APPROXIMATOR (IN SIX FITS).

Cecil Hastings, Jr. and James P. Wong, Jr. June 12, 1953. 24p. (P-404(RAND))

A distinctive visual approach is used to develop methods for best-fit curve approximations to a given set of experimental data. Polynomial approximations to inconvenient mathematical expressions are discussed, together with error curve determinations for data fitting. (K.S.)

## MEASURING INSTRUMENTS AND TECHNIQUES

521

Air Force Cambridge Research Center

INSTRUMENTATION FOR GEOPHYSICAL RESEARCH.

[REPORT] NO. 2. A ROCKET-BORNE EQUIPMENT FOR THE MEASUREMENT OF INFRARED RADIATION. Robert M. Slavin. Feb. 1953. 19p. (AFCRC-TR-53-2)

The rocket-borne equipment described was designed to measure sky-background radiation in the region around 8000 Å and in the range from  $3 \times 10^{-12}$  to  $3 \times 10^{-7}$  w/cm<sup>2</sup>/sq deg. The CE25V-A/B phototube used as the sensing element is magnetically modulated to provide a 120-cps signal to the three-stage amplifier. Rectifier-cathode-follower output circuits provide voltages for telemetering to ground stations during rocket flight. (auth)

622

Argonne National Lab.

THE DETERMINATION OF TRITIUM BY ION CURRENT

MEASUREMENT. K. E. Wilzbach, A. R. Van Dyken, and Louis Kaplan. Oct. 1953. 21p. Contract W-31-109-eng-38. (ANL-5143)

Tritium may be determined by measurement, with a vibrating-reed electrometer, of the ion current produced in a gas within a Borkowski-type ionization chamber. The effect on the ion current of the nature of the filling gas, its pressure, and the collecting voltage is discussed. Samples of gas containing from  $3 \times 10^{-10}$  to 0.01 c in a volume of up to 250 cc may be measured routinely with an accuracy of about 1%. (auth)

623

Brookhaven National Lab.

SOME NEUTRON DETECTION INVESTIGATIONS. C. O.

Muehlhause. Nov. 1953. 12p. (BNL-242)

The design and properties of a fast neutron detector are described. Fast neutron detection is based on the observation that when a fast neutron enters a medium containing both H and some capturing material such as B a pair of events is produced separated in time by 1 sec. This double pulse property is used to distinguish fast neutrons from γ rays or slow neutrons. The scintillation components, the size and construction of the detector, electronic circuits, properties of the counter, and high-multiplicity events affecting performance of the detector are discussed. Methods for detecting slow neutrons are reviewed. It is suggested that large capture γ-ray pulses or capture γ-ray events resulting in a delayed step might be used to differentiate a slow neutron from a γ ray. Methods discussed include a Cd plate counter, gas scintillation counters, and the use of activated ZnS phosphors. (C.H.)

624

Radiation Physics Lab., National Bureau of Standards

CALIBRATION STUDIES OF LANDSVERK 5-R-50-R AND

0.2-R-2-R DUAL-RANGE POCKET CHAMBERS AND NUCLEAR INSTRUMENT AND CHEMICAL CORPORATION 0.2-R POCKET CHAMBERS. R. A. Elmendorf. Sept. 30, 1953. 7p. (NBS-2352)

Three types of pocket ionization chambers were tested for leakage and sensitivity. Data are presented for 16 instruments. (K.S.)

525

Radiation Physics Lab., National Bureau of Standards IONIZATION CHAMBER RESPONSE AS A FUNCTION OF WALL MATERIAL. FOURTH QUARTERLY PROGRESS REPORT COVERING THE PERIOD FROM APRIL 1, 1953 THROUGH JUNE 30, 1953. Frank H. Attix. 54p. (NBS-2771; Quarterly Progress Report 4)

The body of experimental results presented in the Third Quarterly Progress Report has been expanded to include other wall materials and other γ-ray quantum energies. The present report contains curves of ionization current/cm<sup>2</sup> vs. air-gap width for C, Al, Cu, Sn, and Pb chamber walls, with γ- and x-ray effective energies of 38, 70, 118, 169, 206, 411, and 670 kev. Calculations of ionization relative to that produced in a graphite wall or free air chamber, based on the Bragg-Gray theory of cavity ionization, are given. (For preceding period see NBS-2491.) (J.A.G.)

526

RCA Labs. Div., Radio Corp. of America

SCINTILLATION COUNTERS FOR RADIATION INSTRUMENTATION; FINAL REPORT FOR THE PERIOD JULY 1,

1948 TO DECEMBER 15, 1951. P. W. Davison, M. W. Green, M. H. Greenblatt, G. A. Morton, K. W. Robinson, and A. L. Solomon. Dec. 15, 1951. 145p. Contract NObsr-42460. (NP-4650)

An investigation was made of the use of scintillation counters as survey- and monitor-type radiation detection instruments and of the development of special multipliers which may be used in portable instruments. The fundamental aspects of scintillation counting are reviewed, the properties of crystals necessary for the detection of various types of radiation are discussed, and the requirements placed on the photomultiplier are presented. Design and performance of a scintillation counter for α-particle detection are reported. The general features of scintillation counters for γ-ray detection are discussed, and design of a special high-gain photomultiplier suitable for γ-survey instruments, and circuits for use with this instrument are described. Work done on phosphor crystals for γ-ray detection is discussed, and a preliminary evaluation of inorganic, organic, liquid, and plastic phosphors is included. (C.H.)

627

Scientific Specialties Corp.

PHOTOVOLTAIC DOSE RATE INDICATOR. FIRST

QUARTERLY PROGRESS REPORT COVERING THE PERIOD JUNE 1, 1953 THROUGH AUGUST 31, 1953. Richard G. Seed. [1953] 78p. Contract DA-36-039 SC 42727. (NP-4933)

Research and development studies are reported on a batteryless γ-ray survey meter. Preliminary activities included a literature survey of the field, study of the nature of the problem and analysis of various designs for solution, accumulation of specialized elements and apparatus for testing and some simple measurements on photovoltaic cells. Data accumulated indicate that an overall system of extended area (180 cm<sup>2</sup>) and high absorption (50%), with efficiency of 0.1%, would yield an output power of about  $3 \times 10^{-8}$  for 1 r/hr of radiation. A survey of available meters shows that moderately stable suspended galvanometer type instruments may have a sensitivity of  $3 \times 10^{-11}$  for 0.03 of a division. A NaI, Tl-activated single crystal

scintillator may have an efficiency of 8 to 15%. Average Se-on-Fe photovoltaic cells have efficiencies varying from 2 to 6%. Thus a system of scintillator plus photovoltaic cell may be expected to achieve an overall efficiency of 15% to about 2%. Thus it may be possible to satisfy the project requirements with a scintillator plus photovoltaic cell plus galvanometer. The feasibility of layering thin photovoltaic cells to achieve greater x-ray sensitivity, and intensifying phosphors between layers are discussed. (168 references) (auth)

628

De Paul Univ.

SCINTILLATION TECHNIQUES APPLIED TO ELECTRON ENERGY STUDIES. QUARTERLY PROGRESS REPORT NO. 6, [FOR] JULY 1, 1953 TO SEPTEMBER 30, 1953. Edwin J. Schillinger, Jr. 18p. Contract DA-36-039-SC-15505. (NP-4941)

The magnetic deflection device for the electron-accelerating unit described in a previous report has been completed. Tests on the electron-accelerating unit have begun. Some difficulty has been encountered in photo-multiplier reproducibility due to voltage-change sensitivities. Energy resolution of the system is near 1%. Principal effort has been devoted to the scintillation properties of chrysene crystals. Small platelets of chrysene are as efficient as small anthracene platelets in their respective  $\beta$ -counting properties; however, thick chrysene crystals have not yet been proved as effective as similar anthracene samples. (For preceding period see NP-4701.) (K.S.)

629

THE MEASUREMENT OF  $C^{14}$  ACTIVITY IN THE PROPORTIONALITY COUNTER. V. Faltings. Translated from *Naturwissenschaften* 39, 378-9(1952). 4p. (AERE-Trans-11/3/5/283)

An abstract of this paper appears in *Nuclear Science Abstracts* as NSA 6-5836.

630

GEIGER-MUELLER COUNTERS WITH DOUBLE MIXTURES: RARE GAS AND ORGANIC VAPOR. R. Meunier, M. Bonpas, and J.-P. Legrand. *J. phys. radium* 14, 630-4 (1953) Nov. (In French)

After a review of the standard theory of operation of G-M counters, the authors develop necessary conditions which the filling mixture should satisfy for operation with good characteristics. The importance of an additional condition already known, but neglected, is outlined. Several considerations of theoretical chemistry restrict the choice of usable organic vapors of value in counters. The tests which are made to confirm the nature of the formulated necessary conditions, and which permit thinking of those which should be sufficient, are then set forth. Certain established phenomena with standard mixtures (argon-alcohol) are explained by an incomplete analysis of the formulated conditions. The construction of G-M counters, by applying the preceding ideas, demonstrates the importance of the increased possibilities of organic vapor counters, which should, from this fact, remain among the most important of the particle detectors. (tr-auth)

631

TRANSFER ON GLASS AND TREATMENT OF NUCLEAR EMULSIONS WITHOUT SUPPORT. Georges Kayas. *J. phys. radium* 14, 621-2(1953) Nov. (In French)

Various techniques are described for transferring unsupported nuclear emulsions onto glass. (tr-auth)

632

ON A SINGLE-WIRE ELECTROMETER OF HIGH SENSITIVITY. Te-Tchao Ouang, E. Montel, and P. Pannetier. *J. phys. radium* 14, 627-9(1953) Nov. (In French)

An improved single-wire electrometer has been built,

provided with a Wollaston wire of  $1\mu$  diam., which permits charge detection of the order of  $3 \times 10^{-15}$  coulomb, constituting somewhat less than  $2 \times 10^4$  electrons. The technique of preparing such wires is described as well as the mechanical improvements of the apparatus. Finally, the various types of electrometers are compared, and several factors concerning their use are discussed. (tr-auth)

633

A RADIOACTIVE CONTAMINATION DETECTOR. M. Brière and J. Weill. *J. phys. radium* 14, 623-4(1953) Nov. (In French)

An apparatus is described which permits workers handling radioactive products to rapidly check all contamination traces on their hands, footwear, and clothing. The principle employed permits the achievement of an economic apparatus of reliable operation and great convenience. (tr-auth)

634

A NEW SENSITIVE CHEMICAL ACTINOMETER. I. SOME TRIALS WITH POTASSIUM FERRIOXALATE. C. A. Parker. *Proc. Roy. Soc. (London)* A220, 104-16(1953) Oct. 22.

A chemical actinometer has been devised whose high sensitivity and precision depends upon the spectrophotometric determination of the photolysis products of potassium ferrioxalate with 1,10-phenanthroline. The sensitivity is some hundreds of times greater than that of the uranyl oxalate actinometer. The behavior of the actinometer has been investigated in detail at 3650 to 3663 Å, and tests also show that it is suitable for use over a wide range of wavelengths. The approximate quantum efficiency has been determined at 12 wave lengths between 4900 and 2537 Å. The advantages and possible applications of the actinometer in the measurement of small doses of radiation are discussed. (auth)

635

RESOLVING POWER OF THE SCINTILLATION COUNTER FOR ENERGY MEASUREMENT OF RELATIVISTIC PARTICLES. Yujiro Koh. *J. Phys. Soc. Japan* 8, 678-80(1953) Sept.-Oct.

Experiments are reported on the resolving power of a liquid scintillation counter. Straggling effects are particularly emphasized, and a cosmic-ray telescope geometry is described for observing  $\mu$ -meson spectra in conjunction with a scintillation counter. (K.S.)

636

EXPERIMENTAL ANALYSIS OF THE SPECIFIC ACTIVITY. Yoshio Saji, Masakatsu Sakisaka, and Kozo Miyake. *J. Phys. Soc. Japan* 8, 580-3(1953) Sept.-Oct.

In order to measure the absolute number of  $\beta$  particles from samples by an end-window G-M counter, the effects of self-absorption and self-scattering of  $\beta$  rays in samples should be eliminated. Since the apparent number of counts of  $\beta$  rays from samples is generally affected by the effects mentioned, the curve of the specific activity against the thickness of samples shows a maximum at a certain point and gradually decreases as the thickness of samples increases. This curve was analyzed and formulated mathematically of which experimental verification in the case of Ag samples activated by slow neutrons has been obtained. (auth)

MESONS

637

Rochester Univ.  
THE ATTENUATION CROSS SECTIONS OF 37-MEV PIONS IN HYDROGEN. C. E. Angell and J. P. Perry. Sept. 15, 1953. 2p. Contract AT(30-1)-875. (NYO-3831)



638

MULTIPLE PRODUCTION OF PIONS IN NUCLEON-NUCLEON COLLISIONS AT COSMOTRON ENERGIES. E. Fermi. *Phys. Rev.* **92**, 452-3(1953) Oct. 15.

The statistical theory of multiple pion production is applied in some detail to the discussion of nucleon-nucleon collisions for primary energies of 1.75 and 2.2 bev. Probabilities are given for single and multiple productions of pions and nucleons with different charges. (auth)

639

ENERGY SPECTRA OF CHARGED  $\pi$ -MESONS PRODUCED IN CARBON, ALUMINIUM AND COPPER AT 90° TO A 345 Mev PROTON BEAM. Senzo Tokunaga, Kazunori Yuasa, Kiyoshi Nishikawa, and Taka Isii. *J. Phys. Soc. Japan* **8**, 571-4(1953) Sept.-Oct.

Energy spectra of charged  $\pi$  mesons produced in C, Al, and Cu bombarded by a 345-Mev proton beam were obtained with nuclear emulsions. The production cross sections of  $\pi^+$  and  $\pi^-$  mesons from Al are  $5.3 \pm 1.2 \times 10^{-28}$  cm<sup>2</sup> ster<sup>-1</sup> and  $1.9 \pm 0.8 \times 10^{-28}$  cm<sup>2</sup> ster<sup>-1</sup>, respectively. In case of Cu they are  $1.2 \pm 0.2 \times 10^{-27}$  cm<sup>2</sup> ster<sup>-1</sup> and  $3.6 \pm 1.0 \times 10^{-28}$  cm<sup>2</sup> ster<sup>-1</sup>, respectively. By comparing with the cross section of  $\pi$  mesons from C obtained by Richman et al., it is found that the cross section for charged  $\pi$ -meson production varies roughly as mass number A for small A. (auth)

#### NUCLEAR PHYSICS

640

Palmer Physical Lab., Princeton Univ.  
UPPER LIMITS ON THE NEUTRINO MASS FROM THE TRITIUM BETA SPECTRUM. Donald R. Hamilton, W. Parker Alford, and Leonard Gross. [1953?] 20p. Contract AT(30-1)-937. (NYO-6181)

The shape of the tritium  $\beta$  spectrum near the end point has been investigated in a spherical electrostatic integral spectrograph with particular reference to the possible effects of a nonzero neutrino mass. It is shown that the source thickness of 100  $\mu\text{g}/\text{cm}^2$  may be satisfactorily taken into account in the last kilovolt of the spectrum, upon which the results are based. An upper limit to the neutrino mass of 500, 250, and 150 ev is found for the Dirac, Majorana, and Fermi forms, respectively, of the  $\beta$  interaction. (auth)

641

OBSERVATIONS OF MAGNETIC RESONANCES OF HIGH QUANTUM ORDER IN A BEAM OF OPTICALLY ORIENTED SODIUM ATOMS. Jean Brossel, Bernard Cagnac, and Alfred Kastler. *Compt. rend.* **237**, 984-6(1953) Oct. 23. (In French)

The optical method of atomic orientation has allowed an observation of the effect of disorientations produced by the magnetic resonances between Zeeman levels of the Na atom. In addition to the normal resonances observed when the r-f field intensity is weak, high-order resonances of many quanta appear when the r-f intensity is increased. (tr-auth)

#### NUCLEAR PROPERTIES

642

Brookhaven National Lab.  
SOME REGULARITIES IN THE NUCLEAR LEVEL SPACINGS OF Hg, Au, AND Pt. J. W. Mihelich, Brookhaven National Lab. and A. de Shalit, Laboratory for Nuclear Science and Engineering, Mass. Inst. of Tech. [1953] 21p. (BNL-1598)

An attempt is made to determine any systematic behavior of nuclear energy levels in a number of heavy elements, as the number of protons (for a fixed neutron number) or neutrons (for a fixed proton number) is changed. Certain

regularities in the movement of levels are pointed out and discussed. The occurrence of "pure" M1 and mixed M1+E2 transitions (in odd A nuclei) as related to the type of odd particle and the change in orbital angular momentum is summarized. Empirical evidence for L subshell conversion regularities for M4 and E3 multipole orders is given. An extension of this work is suggested. (auth)

643

Brookhaven National Lab.  
NUCLEAR SPECTROSCOPY OF NEUTRON DEFICIENT Hg ISOTOPES. L. P. Gillon, K. Gopalakrishnan, and A. de Shalit, Palmer Physical Lab., Princeton Univ. and J. W. Mihelich, Brookhaven National Lab. [1953] 52p. (BNL-1599)

In order to extend the knowledge of nuclear-level systematics in the Pt-Au-Hg region, neutron-deficient isotopes of Hg were produced by high-energy proton bombardment of Au. A technique is described for the analysis of the very complex internal conversion electron spectra present in the decay chains of Hg isotopes produced by Au(p-xn)Hg reactions where x = 1 to 8 or 9. More or less complete decay chains from Hg to Pt or Ir are postulated for masses 195 to 190 or 189. (auth)

644

Laboratory for Nuclear Science, Mass. Inst. of Tech.  
A SUMMARY OF THE NUMERICAL RESULTS OF A THEORETICAL STUDY OF THE SCATTERING OF NEUTRONS BY COMPLEX NUCLEI. TECHNICAL REPORT NO. 62. Herman Feshbach, Charles E. Porter, and Victor F. Weisskopf. Aug. 15, 1953. 119p. Contract N5ori-07806. (NP-4944)

A presentation in convenient reference form of the numerical results of a theoretical study of the scattering of neutrons by complex nuclei is given. The quantities which are plotted or tabulated are discussed. (J.E.D.)

645

Palmer Physical Lab., Princeton Univ.  
LEVEL DENSITIES OF NUCLEI FROM THE INELASTIC SCATTERING OF 18 MEV PROTONS. P. C. Gugelot. Oct. 15, 1953. 31p. Contract AT(30-1)-937. (NYO-6182)

The spectra of protons inelastically scattered from Al, Fe, Ni, Cu, Ag, Sn, Pt, and Au have been measured. The energy distribution of the scattered protons is represented only approximately by a Maxwellian distribution. The relative level densities of the target nuclei have been calculated from the proton spectra. The scattering cross sections are compared with the predictions of the statistical model. The results indicate that the observed energy variation of the level densities may not depend on the excitation energy of the residual nucleus primarily, but instead there is some evidence that it is a function of the energy of the emitted particle. (auth)

646

QUADRUPOLE RESONANCE FREQUENCIES OF Cl AND Br NUCLEI IN CRYSTALLINE DICHLOROETHYLENE AND METHYL BROMIDE. H. G. Dehmelt and H. Krüger. Translated from *Z. Physik* **129**, 401-15(1951). 16p. (AEC-tr-1736)

An abstract of this report appears in *Nuclear Science Abstracts* as NSA 5-4242.

647

QUADRUPOLE RESONANCE FREQUENCIES OF  $\text{I}^{127}$  NUCLEI IN CRYSTALLINE COVALENT IODINE COMPOUNDS. H. G. Dehmelt. Translated from *Z. Physik* **130**, 356-70(1951). 16p. (AEC-tr-1739)

An abstract of this report appears in *Nuclear Science Abstracts* as NSA 6-343.

648

THE QUADRUPOLE RESONANCE SPECTRUM IN

CRYSTALLINE ANTIMONY TRICHLORIDE AND THE RATIO OF THE ANTIMONY NUCLEAR QUADRUPOLE MOMENTS. H. G. Dehmelt and H. Krüger. Translated from *Z. Physik* 130, 385-91(1951). 8p. (AEC-tr-1742)

An abstract of this report appears in *Nuclear Science Abstracts* as NSA 5-7238.

649

CONTRIBUTIONS TO THE STUDY OF PURE NUCLEAR QUADRUPOLE SPECTRA IN CRYSTALS. H. Krüger. Translated from *Z. Physik* 130, 371-84(1951). 15p. (AEC-tr-1743)

An abstract of this report appears in *Nuclear Science Abstracts* as NSA 6-344.

650

REGULARITIES IN THE CHANGE OF BINDING ENERGY OF NUCLEONS IN NUCLEI. V. A. Kravtsov. Translated from *Doklady Akad. Nauk S.S.S.R.*, 90, 749-51(1953). 4p. (NSF-tr-115)

An abstract of this report appears in *Nuclear Science Abstracts* as NSA 7-5416.

651

ON THE LOW EXCITED STATE OF  $\text{Li}^7$ . N. W. Tanner and R. G. Uebergang. *Australian J. Phys.*, 6, 357-9(1953) Sept.

The 478-kev excited state of  $\text{Li}^7$  is discussed. The assignment of spin  $\frac{1}{2}$  or  $\frac{3}{2}$  is shown to depend upon the magnetic dipole and electric quadrupole mechanism contributing to the isotropy of the  $\gamma$  radiation. (K.S.)

652

BREMSSTRAHLUNG AND ELECTRON SCATTERING CROSS SECTIONS IN Au FOR 247-MEV ELECTRONS AND POSITRONS. Philip C. Fisher. *Phys. Rev.*, 92, 420-7(1953) Oct. 15.

The absolute cross sections for Au for the top 40% of the bremsstrahlung spectrum have been measured for electrons and positrons of 247-Mev mean energy. A magnetic cloud chamber containing two Au foils was used. The foils were positioned to intercept an electron or alternately a positron beam provided by a magnetic-field analysis of the electron-positron pair members produced in a Pb foil situated in the x-ray beam of the 300-Mev betatron. With the possible exception of the top 2% of the spectrum, electron and positron bremsstrahlung were the same. For quantum energies in the interval 0.604 to 0.927 of maximum, the Bethe-Heitler spectrum is  $8.7 \pm 2.3\%$  above the experimental spectrum. In the same interval the Maximon-Bethe-Davies theory agrees with experiment. Scattering by electrons was also observed as a function of energy of the struck or lowest-energy electron. For these particles having energies between 20 and 130 Mev, the scattering cross section ratios of experiment to theory are  $0.96 \pm 0.06$  and  $1.06 \pm 0.08$  for incident electrons and positrons, respectively. The cross section ratio of electrons to positrons in the same energy interval is  $1.31 \pm 0.13$  for experiment and 1.46 for theory. All errors are probable errors. (auth)

653

POLARIZATION OF NUCLEI IN METALS. Albert W. Overhauser. *Phys. Rev.*, 92, 411-15(1953) Oct. 15.

A new method for polarizing nuclei, applicable only to metals, is proposed. It is shown that if the electron spin resonance of the conduction electrons is saturated, the nuclei will be polarized to the same degree they would be if their gyromagnetic ratio were that of the electron spin. This action results from the paramagnetic relaxation processes that occur by means of the hyperfine structure interaction between electron and nuclear spins. A shift of the electron spin resonance due to the same interaction will occur for large amounts of polarization and should

provide a direct indication of the degree of polarization. (auth)

654

HYPERFINE STRUCTURE OF THE SPECTRA OF DYSPROSIUM, COBALT, VANADIUM, MANGANESE, AND LANTHANUM. Kiyoshi Murakawa and Tohru Kamei. *Phys. Rev.*, 92, 325-7(1953) Oct. 15.

Study of the hfs of the spectra of Dy I and Dy II yielded the result that the nuclear spins of  $\text{Dy}^{161}$  and  $\text{Dy}^{163}$  are very probably  $\frac{7}{2}$ , and their nuclear magnetic moments are approximately equal. The quadrupole moments of Co, V, Mn, and La were deduced by hfs investigation to be  $Q(\text{Co}^{59}) = (0.5 \pm 0.2) \times 10^{-24} \text{ cm}^2$ ,  $Q(\text{V}^{51}) = (0.3 \pm 0.2) \times 10^{-24} \text{ cm}^2$ ,  $Q(\text{Mn}^{55}) = (0.4 \pm 0.2) \times 10^{-24} \text{ cm}^2$ ,  $Q(\text{La}^{139}) = (0.9 \pm 0.1) \times 10^{-24} \text{ cm}^2$ . The eccentricities of odd-proton nuclei were calculated from the existing data, and they were plotted vs. the proton number. It was found that they attain large maxima in light and heavy elements. (auth)

655

THE NUCLEAR MOMENTS OF TECHNETIUM-99. Karl G. Kessler and R. E. Trees. *Phys. Rev.*, 92, 303-7(1953) Oct. 15.

The hyperfine structure in the optical spectrum of Tc has been investigated in the region 3600 to 7000 Å with a Fabry-Perot interferometer crossed with a quartz-prism spectrograph. The light source was a liquid-nitrogen-cooled hollow cathode discharge tube. The nuclear spin and magnetic moments previously reported (*Phys. Rev.*, 80, 905(1950); 82, 341(1951)) are confirmed ( $I = \frac{9}{2}\hbar$  and  $\mu = 5.5 \pm 0.3 \text{ nm}$ ) and are in agreement with a more recent nuclear-induction measurement. The quadrupole moment of  $\text{Tc}^{99}$  is found to be:  $Q = (+0.34 \pm 0.17) \times 10^{-24} \text{ cm}^2$ . (auth)

656

TOTAL NEUTRON CROSS SECTION OF LIQUID ARGON. Janet B. Guernsey and Clark Goodman. *Phys. Rev.*, 92, 323-4(1953) Oct. 15.

By means of liquid A in a specially designed Dewar flask,  $\text{Li}^7(p,n)$  neutrons, and a H recoil counter,  $\sigma_1(A)$  at 2-kev intervals in the range 450 to 1100 kev was measured. The experiment was performed in good geometry by the transmission method. (auth)

657

A LONG-LIVED ACTIVITY IN NEUTRON-IRRADIATED NIOBIUM. David L. Douglas, Anita C. Mewherter, and Robert P. Schuman. *Phys. Rev.*, 92, 369-71(1953) Oct. 15.

An activity has been found in samples of Nb metal irradiated for long periods in the Chalk River reactor. Extensive chemical tests showed that the activity is Nb. The activity is most likely the long-lived ground state of  $\text{Nb}^{94}$ . If so, its half life is estimated as  $(2.2 \pm 0.5) \times 10^4 \text{ yr}$  from its yield. It has a  $0.50 \pm 0.05\text{-Mev } \beta$  and three  $\gamma$ 's,  $0.70 \pm 0.01 \text{ Mev}$  (92%),  $0.87 \pm 0.01 \text{ Mev}$  (92%), and  $1.57 \pm 0.02 \text{ Mev}$  (8%). The capture cross section of  $\text{Nb}^{94}$  is  $15 \pm 4 \text{ b}$ . (auth)

658

NEUTRON TOTAL CROSS SECTIONS AT 20 MEV. Robert B. Day and Richard L. Henkel. *Phys. Rev.*, 92, 358-61(1953) Oct. 15.

With the  $\text{T}(d,n)\text{He}^4$  reaction as a monoenergetic source of neutrons of about 20 Mev, the total cross sections of 13 elements have been measured by a transmission experiment. These cross sections vary approximately as  $A^{2/3}$  as is to be expected from the continuum theory of nuclear reactions. The cross section for H at 19.93 Mev is  $0.504 \pm 0.01 \text{ b}$ . This result, together with other results at lower energies, seems to require a Yukawa potential in both the singlet and triplet n-p states and a singlet effective range that is lower than that obtained from p-p scattering data. (auth)



550

SIGN OF THE QUADRUPOLE INTERACTION OF  $\text{Li}^6$  IN  $\text{LiCl}$ . P. Kusch. *Phys. Rev.* **92**, 268-70(1953) Oct. 15.

The sign of the quadrupole interaction energy of  $\text{Li}^6$  in  $\text{LiCl}$  has been found to be positive. Previous determinations have shown that the quadrupole interaction energy of  $\text{Li}^7$  in the same molecule is also positive. It may, therefore, be concluded that both of the stable isotopes of Li have a quadrupole moment of the same sign, though the sign itself is not known. (auth)

#### NUCLEAR TRANSFORMATION

540

INTERACTION BETWEEN NUCLEON MOTION AND SURFACE VIBRATIONS OF THE NUCLEUS IN THE NUCLEAR PHOTOEFFECT. A. Reifman. *Z. Naturforsch.* **a8**, 505-22 (1953) Sept. (In German)

A nuclear model is developed in which the nucleons in the potential well do not interact directly with each other but only through the surface vibrations of the nucleus, resulting in an equilibrium distribution of excitation energy in the nucleus. The properties of this model are first derived for nonstationary problems. The subsequent application of the model to  $(\gamma, n)$  processes has two principal consequences: the first permits the mechanism of the coupling with the surface vibrations to be calculated, and with it an explanation of the large resonance width (lifetime) of the  $(\gamma, n)$  process, in satisfactory agreement with experiment; the second consequence follows from the independence of the nucleons, in that positive answers can be given to frequently discussed questions concerning resonances. The resonances are calculated and agree both with experiment and with the phenomenological model. (tr-auth)

661

THE PRODUCTION OF PROTONS FROM CARBON BY MONOENERGETIC GAMMA RAYS. John W. Weil and Boyce D. McDaniel. *Phys. Rev.* **92**, 391-400(1953) Oct. 15.

A technique is described for selecting from the interactions produced by a bremsstrahlung spectrum only those arising from essentially monoenergetic quanta. These interactions are selected by requiring a coincidence with the degraded electron which produced the interacting quanta. A study of the photoproduction of protons from carbon was made with 190-Mev monochromatic quanta from the 310-Mev Cornell synchrotron. An energy distribution of the emitted protons was observed at  $60^\circ$ , and an angular distribution of 70-Mev protons was also obtained. Interpretation of these results in terms of a deuteron model gives satisfactory agreement and indicates that the photoproduction process involves only a few nucleons on the average and probably involves just two nucleons a large fraction of the time. Rough quantitative agreement is obtained with experiments on the photodisintegration of the deuteron. (auth)

551

THE NEUTRON SPECTRUM FROM THE  $\text{O}^{18}(\text{d}, \text{n})\text{F}^{19}$  REACTION. Robert L. Seale. *Phys. Rev.* **92**, 389-90(1953) Oct. 15.

The neutron spectrum from the  $\text{O}^{18}(\text{d}, \text{n})\text{F}^{19}$  reaction has been investigated.  $\text{BaCO}_3$  targets enriched in  $\text{O}^{18}$  were bombarded with 2-Mev deuterons, and the emitted neutrons were detected with 100- and 200- $\mu$  Ilford nuclear plates. The method of analyzing the data is discussed in detail. The results of the experiment indicate the presence of 4 excited levels in the  $\text{F}^{19}$  which had not been previously reported. These levels are at 0.9, 2.2, 5.2, and 5.5 Mev. (auth)

663

ANGULAR DISTRIBUTIONS FROM  $(\text{n}, \text{p})$  NUCLEAR REACTIONS. N. Austern, S. T. Butler, and H. McManus. *Phys. Rev.* **92**, 350-4(1953) Oct. 15.

It is shown that angular distributions of high-energy pro-

ton groups from  $(\text{n}, \text{p})$  reactions should evidence sharp maxima near the forward direction, which arise from neutrons with large impact parameters interacting with protons out in the "tails" of the initial nucleus. The positions of these peaks are characterized by the allowed values of orbital angular momenta  $l_n$  with which the neutron can be captured to form the final state. A study of such distributions may lead to information concerning spins and parities of nuclear energy levels, as in the case of stripping reactions. For most nuclei, compound nucleus formation should contribute little to such proton groups. For light nuclei, in order that the sharp maxima stand out above the compound nucleus background, it is probably necessary that the incident neutron energy not be near a resonance of the compound nucleus. (auth)

554

A STUDY OF THE  $\text{H}^3 + \text{He}^3$  REACTIONS. C. D. Moak. *Phys. Rev.* **92**, 383-8(1953) Oct. 15.

The reactions  $\text{H}^3(\text{He}^3, \text{d})\text{He}^4$ ,  $\text{H}^3(\text{He}^3, \text{p})\text{He}^5$ , and  $\text{H}^3(\text{He}^3, \text{p})\text{He}^4, \text{n}^1$  have been studied in the 100- to 800-kev region of bombarding energy. In the case of  $\text{H}^3(\text{He}^3, \text{p})\text{He}^5$ , the proton energy was measured with a scintillation spectrometer; from this measurement, the energy of breakup of  $\text{He}^5$  into a neutron and an  $\alpha$  particle was found to be  $0.95 \pm 0.07$  Mev. At a bombarding energy of 360 kev, the deuterons from the  $\text{H}^3(\text{He}^3, \text{d})\text{He}^4$  were found to be isotropic in the center-of-mass system. The spectrum of protons from the three-body breakup,  $\text{H}^3(\text{He}^3, \text{p})\text{He}^4, \text{n}^1$ , was found to be flat within experimental error from 2 to 8 Mev. Competitions among the various modes of decay of the compound nucleus of  $\text{Li}^6$  do not vary beyond an experimental uncertainty of  $\pm 2\%$  from 200- to 600-kev bombarding energy. The shape of the total cross-section curve, measured from 100 to 800 kev, appears to indicate a nonresonant behavior, similar to the case of the d-d reaction. (auth)

665

PHOTOPROTONS FROM In, Ce, AND Bi. M. E. Toms and W. E. Stephens. *Phys. Rev.* **92**, 362-6(1953) Oct. 15.

The charged particles ejected from In, Ce, and Bi foils by x rays from a 24-Mev betatron were observed in nuclear emulsions. The yields of photoprotons, photodeuterons, and photoalpha particles were determined, and the energy and angular distributions of the photoprotons were measured and compared with theoretical calculations based on the evaporation process and on the direct photoeffect. The energy distributions observed indicate a large fraction of direct photoeffect. A marked forward asymmetry was observed in the angular distributions from In and Bi. (auth)

555

POLARIZATION OF THE GAMMA RAYS IN THE  $\text{F}^{19}(\text{p}, \alpha\gamma)\text{O}^{16}$  REACTION. L. W. Fagg and S. S. Hanna. *Phys. Rev.* **92**, 372-7(1953) Oct. 15.

The polarizations of the 6.13-, 6.9-, and 7.1-Mev  $\gamma$  rays from the  $\text{F}^{19}(\text{p}, \alpha)\text{O}^{16}(\gamma)\text{O}^{16}$ ,  $E_p = 0.87$  Mev, reaction have been observed with the photodisintegration of the deuteron to detect polarization. Range measurements on the photoprotons separated the 6.13-Mev  $\gamma$  ray from the other two, which were only slightly resolved. By knowing the relative intensities of the 6.9- and 7.1-Mev  $\gamma$  rays and their unresolved angular distribution coefficient, it is possible, nevertheless, to deduce the separate polarizations from the observed total polarization. Polarization ratios,  $I(0^\circ)/I(90^\circ)$ , of  $0.9 \pm 0.1$ ,  $1.9 \pm 0.3$ , and  $0.4 \pm 0.3$  were obtained for the 6.13-, 6.9-, and 7.1-Mev  $\gamma$  rays, respectively, emitted at  $90^\circ$  to the proton beam. These values are in good agreement with the polarizations expected for the assignment of a  $2^-$  state in  $\text{Ne}^{20}$  and  $3^-$ ,  $2^+$ , and  $1^-$  states in  $\text{O}^{16}$  as deduced by Seed and French from directional correlation measurements on this reaction. (auth)

## PARTICLE ACCELERATORS

667

Oak Ridge National Lab.

APPLICATION OF THERMOCOUPLES TO TARGET TEMPERATURE MEASUREMENT IN THE INTERNAL BEAM OF A CYCLOTRON. W. J. Sturm and R. J. Jones. Issued Nov. 17, 1953. 4p. Contract W-7405-eng-26. (ORNL-1540)

Investigations on the performance of thermocouples used in cyclotron target temperature measurements are reported. Primary consideration was given to possible anomalous behavior resulting from the bombardment by a high-energy proton beam, the presence of an intense high-frequency r-f field from the dees, and a large magnetic field. With only a choke and condenser bypass in the thermocouple circuit, to reduce the induced r-f potential, it is shown that the melting-point temperatures of Pb, Al, and Ag, melted by the developed heat of the proton beam, were given to within  $\pm 3.7^\circ\text{C}$  by attaching the thermocouple directly to these targets. (K.S.)

668

Radiation Lab., Univ. of Calif., Berkeley

INDEX TO INFORMATION AVAILABLE ON THE 60-INCH CROCKER CYCLOTRON. July 30, 1953. 11p. Contract W-7405-eng-48. (UCRL-1651(rev.))

669

DIELECTRIC PROPERTIES OF PURE HYDROGEN AND APPLICATION TO ELECTROSTATIC GENERATORS AS AN INSULATING MEDIUM. Noël-J. Félici. *Compt. rend.* 237, 979-82(1953) Oct. 23. (In French)

The advantages of H as an insulating gas for generators of low voltage are discussed. Good spark-over resistance is particularly cited as an advantage over conventional gases used in high-voltage machines. (K.S.)

## RADIATION ABSORPTION AND SCATTERING

670

Bartol Research Foundation, Franklin Inst.

SEMI ANNUAL REPORT, JUNE 30, 1952-JANUARY 31, 1953. [MEASUREMENTS OF INELASTIC SCATTERING AND TOTAL NEUTRON CROSS SECTIONS]. W. F. G. Swann. Jan. 31, 1953. 23p. Contract Nonr 436(00). (AD-3487)

A discussion is presented of studies which were made to aid in reducing the background in scattering experiments. Results are given of inelastic scattering by Fe at  $90^\circ$  when shielding was used between the detector and neutron source. Total neutron cross sections were determined for Mg, Au, Cl, and P for energies up to 700 kev. The yield of neutrons in the forward direction from the  $\text{H}^3(p,n)\text{He}^3$  reaction was calculated, and results are presented. (For preceding period see NP-4300.) (L.M.T.)

671

Brookhaven National Lab.

RECENT MEASUREMENTS ON THE LOWEST NEUTRON SCATTERING RESONANCE IN COBALT (abstract). F. G. P. Seidl. Sept. 22, 1953. 1p. (BNL-1591)

672

Nuclear Development Associates, Inc.

INTERIM REPORT ON THE NDA-NBS CALCULATIONS OF GAMMA RAY PENETRATION. Herbert Goldstein, J. Ernest Wilkins, Jr., and Stanley Preiser. Sept. 8, 1953. 76p. Contract AT(30-1)-862. (NDA-MEMO-15C-20)

Data on  $\gamma$ -ray penetration in Al, Fe, Pb, Sn, W, U,  $\text{H}_2\text{O}$ , and a Compton scatterer are presented preliminary to a final report on penetration calculations to be distributed before the first quarter of 1954. A section of the report is devoted to an exposition of the moments method for calculating  $\gamma$  penetration. Following this is a discussion of the com-

putational techniques of applying such a method to high-speed calculating machines, together with a sampling of the results obtained to date. Differential energy spectra for point-isotropic  $\gamma$  sources of various energies are given for  $\text{H}_2\text{O}$ , Fe, and Pb. Build-up factors are tabulated for point-isotropic and plane-monodirectional source geometries of various energies. Further reports will include photon source distributions represented by the  $P_1$ ,  $P_2$ , and  $P_3$  Legendre polynomials. (K.S.)

673

Nuclear Development Associates, Inc.

STATUS REPORT ON CALCULATION OF GAMMA RAY PENETRATION. H. Goldstein and R. Aronson. Aug. 20, 1953. 28p. Contract AT(30-1)-862. (NYO-3079; NDA-15C-1)

The current status of the work on  $\gamma$ -ray penetration is examined. The calculations already accomplished are reviewed, and the application of these calculations to the design of practical reactor shields is discussed. Brief comments on the direction the program should take in the future are included. (C.H.)

674

Carnegie Inst. of Tech.

HALF LIFE OF POSITRONS IN CONDENSED MATERIALS. Howard J. Richings. May 1953. 52p. Contract AT(30-1)-882. (NYO-3658)

The half life of positrons in various condensed materials has been investigated by means of coincidence circuitry capable of measuring lifetimes down to  $10^{-10}$  sec. Within an error of  $0.5 \times 10^{-10}$  sec the half lives were the same and probably shorter than  $10^{-10}$  sec for all conductors studied, including the alkali series. Since the annihilation of free positrons against the conduction electrons would give an observable dependence on electron density, this result indicates the formation of bound states between the positron and electron. Longer half lives (up to  $2.5 \times 10^{-10}$  sec) were found in certain insulators characterized by great chemical stability (such as paraffin), while in other less stable insulators the results were the same as with conductors. These results seem to indicate the formation of positron compounds. A particular case indicating the formation of a compound with O is found in  $\text{H}_2\text{O}_2$ , since the positron half life in this substance is noticeably shorter than in  $\text{H}_2\text{O}$ . One concludes that the technique used can be of some value in the study of the chemical properties of the positron. (auth)

675

Radiation Lab., Univ. of Calif., Berkeley

THE DISTRIBUTIONS IN ENERGY AND IN NUMBER OF ELECTRONS AND PHOTONS IN CASCADE. DERIVED WITH ENERGY-DEPENDENT BREMSSTRAHLUNG, MATERIALIZATION, COLLISION LOSS AND MULTIPLE SCATTERING. Bayard Rankin. Sept. 17, 1953. 41p. Contract W-7405-eng-48. (UCRL-2322)

Diffusion equations for a cascade shower which include an energy cutoff (below which the electrons and photons are no longer observed) and energy parameters for each particle have not previously been studied. In this paper it is found that an inclusion of both permits collision loss to be represented as a discrete process by modifying the differential radiation cross section. It is assumed that (in addition to the continuous spectrum of radiation losses) energy is lost through collision in amounts equal to the cutoff energy. The foreshortening of the shower penetration by multiple scattering is accomplished by increasing the radiation and collision loss cross sections by the ratio of the integrated to the projected electron path length. The correction ratio can be made a function of energy, as can the cross sections. Full screening approximations are unnecessary. After integrating over the energy variables



and resorting to the matrix notation of Messel and Potts, the equations are written and solved as a double recurrence relation. The distribution functions themselves are obtained, rather than their moments. They are expressed in terms of products and sums of matrices and one-dimensional integrations. The mathematical approximations necessary to bring a solution appear in the energy integrations and become better when the energy cutoff is small compared to the energy of the shower primary. With better approximation, however, more addition and multiplication of matrices are required in order to achieve a numerical solution. (auth)

676

Radiation Lab., Univ. of Calif., Berkeley  
**MESON NUCLEON SCATTERING. [PART] 1.** R. J. Riddell, Jr. and B. D. Fried. Oct. 1, 1953. 53p. Contract W-7405-eng-48. (UCRL-2341)

An approximate quantum mechanical solution of the meson-nucleon scattering problem for intermediate values of the coupling constant is presented. The particular case treated is that of charged scalar mesons interacting with a static nucleon. In finding the cross section, attention is focused upon the matrix elements of the field and isotopic spin operators and on the equations of motion, no attempt being made to calculate explicitly the scattering-state vector. It is shown that in both the weak- and strong-coupling limits the procedure described gives the scattering correctly. For intermediate coupling the cross section must be found numerically. Computations have been carried out for several intermediate values of the coupling constant, and the results are presented in the form of curves showing cross section vs. meson energy. Since certain information about the one nucleon problem (i.e., one real nucleon and no real mesons) is needed for these calculations, a detailed numerical solution of that problem has been carried out by means of the Tomonaga approximation. The relevant results of this work are presented in several graphs. Although it is not a part of the scattering problem, the calculation of the isobar separation in the strong-coupling limit can be carried out so easily by the methods of this paper that a brief account of it is also given. In the appendix, a variational method of calculating the scattering-state vector for intermediate coupling is described. It is shown that this, however, fails to give the correct strong-coupling limit. (auth)

677

Radiation Lab., Univ. of Calif., Berkeley  
**A NOTE ON THE PRODUCTION OF POSITIVE MESONS IN HEAVY NUCLEI.** S. Gasiorowicz. Sept. 30, 1953. 15p. Contract W-7405-eng-48. (UCRL-2348)

The data on the A dependence of low-energy meson production by protons on heavy nuclei is explained by taking into account the following effects: (1) the energy degeneration of the incident proton in nuclear matter, which tends to make meson production possible only in the "front" of the struck nucleus; (2) the subsequent re-absorption of the meson by the nuclear matter it traverses. This last effect is further strengthened by the reflectivity of the Coulomb barrier. (auth)

678

**THE PASSAGE OF NUCLEONS THROUGH MATTER.** D. I. Blokhintsev [Blokhintsyev]. Translated by Henry P. Kramer from Zhur. Eksptl'. i Teoret. Fiz. 19, 953-8(1949). 16p. (UCRL-Trans-80)

An abstract of this report appears in Nuclear Science Abstracts as NSA 4-1299.

679

**THE SCATTERING OF 1 MEV ELECTRONS AND POSITRONS.** J. A. McDonnell. Australian J. Phys. 6, 245-61 (1953) Sept.

Electrons and positrons of energy 1 Mev were selected by a  $\beta$ -ray spectrometer and scattered by a Au foil. The scattered particles were detected by a coincidence Geiger counter arrangement, by use of the same geometry for electrons and positrons. The results show that the ratio of the fraction of electrons scattered through an angle  $\theta$  to the fraction of positrons scattered through  $\theta$  varies with  $\theta$ , and the magnitudes of the ratios agree with those predicted by theory. It is also inferred that there is a difference between the multiple scattering of electrons and positrons under the same scattering conditions. (auth)

680

**STRONG COUPLING THEORY OF MESON SCATTERING.** Allan N. Kaufman. Phys. Rev. 92, 468-81(1953) Oct. 15.

The strong-coupling theory of meson scattering by nucleons is extended to second order in the inverse of the coupling parameter  $g$  for the case of a charged scalar field. The ordinary and charge-exchange scattering amplitudes for positive and negative mesons are calculated by a perturbation expansion in  $g^{-1}$ , in terms of the normal modes of the  $g^0$  order Hamiltonian, taking into account the inelasticity caused by the existence of isobaric levels of the compound nucleon. (auth)

681

**HIGH-ENERGY ELECTRON SCATTERING BY NUCLEI.** R. W. Pidd, C. L. Hammer, and E. C. Raka. Phys. Rev. 92, 436-7(1953) Oct. 15.

The Michigan race-track synchrotron has been used as a source of electrons for the study of elastic scattering of 30- to 45-Mev electrons by nuclei of  $Z = 46$  to 52 and  $Z = 74$ . The experimental results for  $W$  can be interpreted to give a value of the nuclear radius equal to  $(1.0 \pm 0.1) \times 10^{-13}$  A  $^{1/3}$  cm if a constant proton density is assumed for the nucleus. The radius of the Sn nucleus is  $(1.1 \pm 0.1) \times 10^{-13}$  A  $^{1/3}$  cm. Any discontinuity in  $r_0$  vs.  $A$  at the closing of the  $g_{3/2}$  shell is about 1% or less; a step increase of 2% at  $Z = 48$  gives a best fit to the lower  $Z$  data. (auth)

682

**THE ELASTIC SCATTERING OF PARTICLES BY ATOMIC NUCLEI.** N. C. Francis and K. M. Watson. Phys. Rev. 92, 291-303(1953) Oct. 15.

The description of the elastic scattering of particles by atomic nuclei in terms of the optical model is studied. It is shown that the optical model does not represent only an approximation to the many-body problem, although the optical model potential must in general be considered to contain spin-orbit couplings. An explicit expression is obtained for the optical model potential in terms of the amplitudes for scattering of the incident particle by the individual neutrons and protons of the nucleus. The potential also depends upon correlations in the positions of the nuclear particles. A calculation of the parameters of the optical model seems to be in good agreement with some meson scattering experiments. (auth)

683

**ATTENUATION OF GAMMA RAYS. I. TRANSMISSION VALUES FOR FINITE SLABS OF LEAD, IRON, AND THE COMPTON SCATTERER.** Glenn H. Peebles. J. Appl. Phys. 24, 1272-87(1953) Oct.

An approximate integral recursion formula is developed which gives a relation between the probability that a photon will be transmitted through a slab of finite thickness with exactly  $k + 1$  collisions and the probability that it will be transmitted with exactly  $k$  collisions, where the latter probability is known for suitable ranges of slab thickness, of incident energy, and of incident angle. A similar formula also exists for the expected energy transmitted. The two recursion formulas have been used to calculate the transmissions with one, two, and three scatterings for photons incident on slabs of Pb and of Fe, and from these



calculated transmissions the "build-up" factors have been estimated. The build-up factor for normally incident photons of 1 to 20  $\text{mc}^2$  are given for Pb slabs and for Fe slabs having a thickness of 0 to 20 mean free paths. A second method, which considers the transmission through a thick slab as a succession of transmissions through thin slabs, is used to check the estimates of the build-up factor obtained by the first method. This second method provides additional information in the form of the distributions of the transmitted photons. Finally, some transmission and reflection values for thin slabs of the Compton scatterer are presented along with some results for air which are obtained by the second (thin-slab) method. (auth)

#### RADIATION EFFECTS

684

Carnegie Inst. of Tech.

CHANGE OF ELECTRICAL CONDUCTIVITY OF SODIUM CHLORIDE UPON BOMBARDMENT WITH HIGH ENERGY PROTONS. Edgar E. Pearlstein. Oct. 25, 1953. 10p. Contract AT-(30-1)-1193. (NYO-3127)

The conductivity of NaCl in the region 125 to 400°C is considerably decreased by bombardment at room temperature with  $10^{15}$  protons/ $\text{cm}^2$  of energy 350 Mev. There are several temperatures where part of the effect anneals. A small decrease in conductivity still remains after heating to as high as 470°C. No satisfactory explanation for the results is evident. (auth)

#### RADIOACTIVITY

685

Brookhaven National Lab.

DECAY SCHEME OF  $\text{Se}^{78}$  AND  $\text{Ge}^{78}$ . A. W. Schardt and Joan P. Welker. [1953] 1p. (BNL-1589)

686

Mound Lab.

THE HALF LIFE OF LANTHANUM-140. H. W. Kirby and Murrell L. Salutsky. July 31, 1953. 9p. Contract AT-33-1-1-GEN-53. (MLM-890)

Carrier-free  $\text{La}^{140}$  was separated by  $\text{Ba}(\text{NO}_3)_2$  precipitation from  $\text{Ba}^{140}$  previously purified by a  $\text{BaCrO}_4$  precipitation with inert Ba carrier. The half life, determined by  $\beta$  counting, was found to be  $40.224 \pm 0.020$  hr over a period of 574 hr. (auth)

687

Carnegie Inst. of Tech.

NATURAL ALPHA ACTIVITY OF NEODYMIUM. Esther C. Waldron, Virginia A. Schultz, and Truman P. Kohman. Nov. 1, 1953. 6p. Contract AT(30-1)-844. (NYO-3624)

By the use of impregnated nuclear track plates, a natural  $\alpha$  activity has been found in Nd which had been highly purified, especially from Sm, by ion-exchange fractionation. Reasons are given for assigning the activity to  $\text{Nd}^{144}$ . The particle energy is  $1.9 \pm 0.1$  Mev. The specific activity is 0.015  $\alpha/\text{sec/gm Nd}$ , corresponding to a half life for  $\text{Nd}^{144}$  of  $1.5 \times 10^{15}$  yr; these figures are uncertain by a factor of at least 2. (auth)

688

THE RADIATIONS OF  $^{159}\text{Gd}$  (18hr) AND  $^{161}\text{Gd}$  (3.7 min). W. C. Jordan, J. M. Cork, and S. B. Burson. *Phys. Rev.* 92, 315-18(1953) Oct. 15.

The radiations from  $\text{Gd}^{159}$  (18 hr) and  $\text{Gd}^{161}$  (3.7 min) were studied with 180° photographic electron spectrometers and a scintillation coincidence spectrometer. For  $\text{Gd}^{159}$  (18 hr) internal conversion lines corresponding to  $\gamma$  transitions of  $57.5 \pm 0.3$  and  $364 \pm 3$  keV in  $\text{Gd}^{159}$  are observed. Peaks due to the K x ray and the 364-keV  $\gamma$  ray are observed in the NaI pulse-height distribution. The results of coincidence measurements indicate that the two  $\gamma$  transitions are not in

cascade, but that the 57-keV  $\gamma$  is preceded by a  $\beta$  transition of  $\sim 1.1$  Mev, while the 364-keV  $\gamma$  is preceded by a  $\beta$  transition of  $\sim 0.9$  Mev. The half life of  $\text{Gd}^{161}$  is found to be  $3.73 \pm 0.10$  min. Aluminum absorption measurements indicate an energy of  $\sim 1.6$  Mev for the  $\beta$  transition. Peaks are observed in the pulse-height distribution corresponding to  $44 \pm 1$  (Th K x-ray),  $102 \pm 3$ ,  $\sim 165$ , and  $\sim 360$  keV. The high-energy peak is resolved into two peaks in coincidence distributions, showing the 360-keV transition to be coincident with the x ray, and a 316-keV transition to be coincident with the 102-keV  $\gamma$  ray. The K internal-conversion line for the 316-keV transition is observed, plus some other weak conversion lines corresponding to the other transitions. All of the electromagnetic radiation appears to be coincident with a  $\beta$  transition of  $\sim 1.6$  Mev. The existence of a  $\gamma$  transition of  $\sim 60$  keV is suggested. (auth)

689

THE RADIOACTIVE DECAY OF CALCIUM 47. J. M. Cork, J. M. LeBlanc, M. K. Brice, and W. H. Nester. *Phys. Rev.* 92, 367-9(1953) Oct. 15.

Spectrometric studies have been made of the  $\beta$  and  $\gamma$  radiations from  $\text{Ca}^{47}$  and its radioactive daughter  $\text{Sc}^{47}$ . By means of conversion and photoelectrons and the scintillation spectrometer,  $\gamma$  rays of energy 149.5, 234, 495, 800, and 1303 keV are found in Sc following  $\beta$  emission from the Ca. The  $\beta$  spectrum is complex with energies of 0.46 and 1.4 Mev.  $\text{Sc}^{47}$  decays with a single allowed  $\beta$  transition with upper energy limit of  $0.64 \pm 0.03$  Mev and a single  $\gamma$  ray of 159.5 keV. A satisfactory level scheme is proposed for the decay and checked in some of its details by coincidence observations. (auth)

690

BETA-SPECTRUM OF  $\text{Ni}^{63}$ . Yoshiyuki Kobayashi, Goro Miyamoto, and Shigeru Mori. *J. Phys. Soc. Japan* 8, 684-5(1953) Sept.-Oct.

New data are reported on the  $\beta$  spectrum of  $\text{Ni}^{63}$ . A good agreement is noted between the observed and theoretical a-type spectra. The end-point energy was determined to be  $61.5 \pm 1$  keV. The value of  $\log ft$  was found to be 4.3 for the 60-yr half life. Fermi plots of the spectrum are included. (K.S.)

#### SHIELDING

691

Brookhaven National Lab.

AN ECONOMICAL WATER- AND EARTH-SHIELDED COBALT-60 GAMMA-RAY SOURCE. Harold A. Schwarz and Augustine O. Allen. [1953] 7p. (BNL-1604)

The design and performance of a shielding arrangement for multicurie  $\text{Co}^{60}$   $\gamma$ -ray sources are described. The Co is kept under  $\text{H}_2\text{O}$  in a pipe buried in the ground under the laboratory floor. Samples for irradiation are placed in a  $\text{H}_2\text{O}$ -tight can which is lowered into a hole. Water and earth are the only shield, and the arrangement is convenient and economical. By circulating the  $\text{H}_2\text{O}$  from a thermostat in the laboratory, accurate temperature control is easily secured. The present design would apparently offer completely adequate shielding for a 12,000-c source. (J.A.G.)

692

Yale Univ.

RADIATION-SHIELDING DOORS. W. G. Wadey. [1953?] 5p. Contract AT (30-1)-1349. (NYO-6300)

Concrete doors 2 to 4 ft thick for radiation shielding are described. The hinge and load-bearing gate are so designed that the doors can be opened by one man with no possibility of being trapped by loss of the electric power or failure of a hydraulic mechanism. (C.H.)



## SPECTROSCOPY

693

Brookhaven National Lab.

THE FLUORESCENCE SPECTRUM OF TRIPHENYL-METHYL AT 4°K. S. I. Weissman, Washington Univ., St. Louis and Brookhaven National Lab. [1953?] 4p. (BNL-1610)

The fluorescence spectrum of triphenylmethyl at 4°K was obtained. In an interval of  $1900\text{ cm}^{-1}$  104 lines were observed. (J.S.R.)

694

Ames Lab.

A PROPORTIONAL COUNTER SPECTROMETER STUDY OF THE BETA-DECAY OF RADIOACTIVE  $\text{S}^{35}$ ,  $\text{Pm}^{147}$ ,  $\text{Ni}^{63}$ , AND  $\text{C}^{14}$ . J. P. Mize and D. J. Zaffarano. Mar. 1953. 47p. Contract W-7405-eng-82. (ISC-347)

The design and performance of a proportional counter spectrometer constructed for the purpose of measuring  $\beta$  spectra with energies lying below a few hundred kev are described. The data yielded a straight Fermi plot from the upper-energy end point to 15 Kev for  $\text{Pm}^{147}$ . The end point of  $\text{Ni}^{63}$  was found to be 63 Kev with the Fermi plot concave toward the energy axis below 30 Kev. The upper-energy end point of  $\text{C}^{14}$  was found to be in good agreement with previous magnetic measurements, but the Fermi plot of the data was concave toward the energy axis below 50 Kev. The correction for the theoretical energy-dependent shape factor of Konopinski (Revs. Mod. Phys. 15, 209(1943)) for a second forbidden transition with Fermi selection rules tended to straighten the obtained Fermi plot of  $\text{C}^{14}$ . (J.A.G.)

695

Massachusetts Inst. of Tech.

INVESTIGATIONS OF ISOTOPIC ABUNDANCES OF STRONTIUM, CALCIUM AND ARGON IN CERTAIN MINERALS. PROGRESS REPORT FOR PERIOD, MAY 1 [TO] OCTOBER 1, 1953. L. F. Herzog, P. M. Hurley, and L. H. Ahrens. Oct. 21, 1953. 14p. Contract AT(30-1)-1381. (NYO-6299)

Progress is reported on changes and additions that were made on the solid-source spectrometer. No data were obtained. (J.A.G.)

696

CHANGE IN THE INVERSION SPECTRUM OF  $\text{ND}_3$  FROM RESONANT TO NONRESONANT ABSORPTION. G. Birnbaum and A. A. Maryott. Phys. Rev. 92, 270-3(1953) Oct. 15.

The absorption due to the inversion spectrum of  $\text{ND}_3$  centered near 1600 Mc was measured at pressures from 0.3 to 80 cm Hg in the frequency interval 1100 to 2600 Mc. The inversion frequency was found to decrease with increasing pressure and became substantially zero at about 9 cm Hg. This change occurs at pressures about 15-fold lower than for  $\text{NH}_3$ , a result in accord with Margenau's theory. At the higher pressures where the absorption is of the nonresonant or Debye type, the collision diameter is about 6.9 Å, a value roughly one-half that associated with resonant absorption at low pressures. (auth)

## THEORETICAL PHYSICS

697

ON ANNIHILATED PHOTONS AND ELECTROMAGNETIC INTERACTIONS. Serge Slansky. Compt. rend. 237, 972-3 (1953) Oct. 23. (In French)

Several properties of the magnitude  $n_0$  occurring in photon wave mechanics are studied as a representation of the number of annihilated photons. Results of the analysis indicate that the usual expression for the photon-electron interaction is a good approximation in the limiting case where  $n_0$  is infinite. (K.S.)

698

EXPLICIT MATRIX ELEMENTS FOR MULTIPOLE RADIATION. P. B. Treacy. Australian J. Phys. 6, 241-4(1953) Sept.

By use of a simple model, a formula is given for the radiation intensity from a multipole of any order. This formula is extended to include polarization properties of quanta. As an example, a matrix element is calculated for multipole radiation of order four. (auth)

699

HYPERFINE STRUCTURE FORMULAS FOR LS COUPLING. R. E. Trees. Phys. Rev. 92, 308-14(1953) Oct. 15.

Formulas for the interval factor A and the quadrupole-coupling factor B in the hyperfine structure formula,  $W = W_J + \frac{1}{2}AK + BK(K+1)$ , are derived with Racah's tensor algebra. The results are directly applicable to light atoms ( $Z < 50$ ) that show good LS coupling. Data of White and Ritchie for Mn are analyzed, and an approximate value of the nuclear quadrupole moment in  $\text{Mn}^{55}$  of  $Q = 1 \times 10^{-24}\text{ cm}^2$  is obtained. This confirms another approximate value of  $Q = 0.5 \times 10^{-24}\text{ cm}^2$  recently obtained by microwave methods. An error in the calculation carried out by Brown and Tomboulou to evaluate the Q of Ta is noted. A relation satisfied by X functions is derived, which simplifies their numerical evaluation. (auth)

## URANIUM AND URANIUM COMPOUNDS

700

NEUTRON AND SPONTANEOUS FISSION IN URANIUM ORES. W. H. Fleming and H. G. Thode. Phys. Rev. 92, 378-82(1953) Oct. 15.

The fission yields of the stable isotopes of Xe and Kr in natural fission have been determined for six samples of pitchblende and one sample of uraninite. The fission yields observed varied markedly from sample to sample. The nature of these variations and particularly the changes that occur in the "fine structure" of the mass yield curves at  $\text{Xe}^{132}$  and  $\text{Xe}^{134}$  indicate that both spontaneous fission of  $\text{U}^{238}$  and neutron fission of  $\text{U}^{235}$  occur in U minerals, the proportion of each depending on the U concentration, geological age, and the impurities in the mineral. This conclusion is consistent with estimates of the neutron flux in these ores based on the abundance of  $\text{Pu}^{239}$  in pitchblende. (auth)

701

OBSERVATION OF THE POLYGONIC STRUCTURE OF URANIUM BY X-RAY DIFFRACTION. Adrienne R. Weill and Pierre A. Jacquet. Compt. rend. 237, 1002-3(1953) Oct. 23. (In French)

Extremely fine pieces [of U] have been prepared by electrolytic polishing, often formed from a single crystalline grain. Examination by x-ray diffraction permits a study of the grain substructure, where the polygonic structure is not very fine. This technique provides for the simultaneous comparison of microscopic and radiocrystallographic examinations. (tr-auth)



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